

The Impact of Governance Regime on Land Cover and Use Change and Forest Structure: Insights from Kakamega and Loita Forests, Kenya

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Abstract

Forests in Kenya are managed under different management regimes, including traditional community based forest management, command and control, participatory forest management, leasehold, concessions, and private. Assessment of these regimes' impact (positively or negatively) on forest conservation has not been done. The study was done to determine the impact on forest conservation of three management regimes traditional community based forest management, command and control, and participatory forest management. The survey was done through secondary data, focus group discussion, key informant interview, household survey, ecological survey, and land cover and land use analysis through GIS. The results indicate that the forest site under participatory forest management witnessed better forest management. In this site, the forest zone witnessing best management was the one near the forest station where the rangers are located and adjacent to the community that has been involved in forest management and benefited most from project intervention, an incentive for their participation in forest management. The forests under traditional community based forest management faced a high forest degradation rate. Forest under command and control regime witnessed the best forest condition improvement attributed to the management regime not allowing consumptive forest resource utilization. Each regime was best under its' legislative framework and would facilitate better forest management and contribute to improved livelihoods without compromising forest quality. Participatory forest management was the most preferred management

regime contributing to better forest management, improved community livelihoods, and formally involved communities and other stakeholders. Each regime's appropriateness would be enhanced through stakeholder capacity building, institutional reform, adequate financial facilitation, and appropriate implementation. Therefore, adopting participatory forest management attributes to the other two management regimes would enhance their appropriateness, while appreciating that the management objective determines the regime being implemented in each forest.

Keywords

Forest, Regime, Appropriateness, Management, Livelihoods

1. Introduction

Forests globally continue to face unprecedented degradation levels due to competing interests and poverty, leading to resource use and access conflicts. Decentralization was perceived as the solution to mitigate struggles for control over and access to nature and natural resources; struggles over land, forests, pastures, and fisheries are struggles for survival, self-determination, and meaning (Ribot, 2016). The need to decentralize was also because centralized state management of forests is costly, financially unsustainable, and creates animosity between resource stakeholders leading to deforestation, degradation and poverty among the adjacent forest communities (Banana et al., 2008). Decentralization facilitates several stakeholders' involvement in forest management, especially communities, and emerged in different places between the 1970s and 1990s. Decentralization was a response to a combination of factors, with key drivers being forest degradation and deforestation occurring due to decades of overexploitation from industrial logging (Poffenberger, 2006, as cited in Charnley & Poe, 2007). Decentralization leads to better environmental management, devolution of powers over the disposition of resources, improving community livelihoods, and managing divergent multi-stakeholder interests while ensuring equity of costs and benefits (Wyckoff-Baird et al., 2000; Warui, 2016; Bulut & Abdow, 2018). Better management of natural resources is central to rural lives and livelihoods because they provide the material resources for survival (wealth and subsistence), security, and freedom (Ribot, 2016).

Participatory Forest Management (PFM), joint forest management, and community forest management are among the variants of decentralization, as noted by Mogoi et al. (2012). They do not include command and control and traditional community-based forest management approaches, which are still applied in the forest sector. The shift to community participation in forest management has been prompted by centralized state control's ineffectiveness, recognition of the local operational structures, and acknowledging that communities and other local groups possess management capacity (Obare, 2003). Further, protected areas

that adopt co-management regimes and empower local people are more likely to report positive conservation outcomes and better livelihood outcomes (Oldekop et al., 2015). Since the beginning of the 1990s, waves of natural resources management decentralization experiments have been implemented in Africa, generating positive and negative impacts (Oyono, 2005; Ribot, 2016). Uganda had the first attempt to decentralize the forestry sector by establishing legislation for establishing local forest reserves under the district administration in 1939-1947 but gained momentum in 1993 (Banana et al., 2008).

Forest management in Kenya was under Command and Control (C and C), but community participation in the forestry sector in Kenya can be traced back to Sessional Paper No 10 of 1965 that promoted that people be informed, and their cooperation ensured for maintenance of forests and windbreaks (Government of Kenya—GoK, 1965). Since 1902 when the Forest Department was established in Kenya, the forestry sector has undergone important transitions in administrations, roles, functions, and orientation (Ogada, 2012). The failures of centralized (command and control where the government manages forest without the participation of other stakeholders) management approach in Kenya were widely acknowledged, especially in the 1980s (MENR, 1994; Wass, 1995). The main causes for the failure included; vast sizes of some of the forests, inadequate management resources (financial and administrative—human and physical), insufficient technological and enforcement capacity, corruption, interference with local institutions managing forests, management decisions that favoured commercial utilization, inadequate information about the forests and failure to appreciate the opportunity offered by partnerships with communities and other stakeholders (MENR, 1994; Ogada, 2012; GoK, 2016a). Participatory Forest Management, as a decentralizing form of forest governance, emerged in Kenya in the late 1990s (Kenya Forest Service (KFS), 2015a; Matiku et al., 2013; Mbuvi & Musyoki, 2013; Chomba et al., 2015; Kimutai & Watanabe, 2016; Mutune et al., 2017). It was under the decentralization rubric to escape from the traps of ineffective and inefficient governance, macroeconomic instability and inadequate economic growth similar to other parts of the world, as noted by Ebel and Yilmaz (2001, cited in Sharma, 2005). The key drivers were: forest degradation occurring due to decades of overexploitation from industrial logging, failure to involve other forest management stakeholders, and communities not benefiting (GoK, 2016a).

This study was done when The Forests Act (GoK, 2005) was operational, which has been revised in 2016 (GoK, 2016b) in line with The Constitution 2010 (GoK, 2010) to the Forest Conservation and Management (FCM) Act (2016). The FCM Act (2016) recognises partnering with Non-Governmental Organisations (NGOs), Civil Society Organisations (CSO), and communities in forestry management (GoK, 2016b). These new entrants have put pressure on the Government to be assigned forest management roles, leading to the introduction of PFM, leasehold, and concession, among other management, approaches in Kenya's

forest sector. Impacts of the variants decentralized forest governance and traditional community-based forest management regime on forests and community livelihoods have not been entirely determined in Kenya, as noted by Guthiga (2007). Additionally, forestry decentralization through PFM in Kenya is relatively new, with enabling legislation having been approved in 2007 (Banana et al., 2008; Mbuvi & Musyoki, 2013). In this paper, the management regimes have been limited to; traditional community-based forest management, command and control, and PFM. The regimes are defined based on the conceptual schema for arraying property-rights regimes that distinguish among diverse bundles of rights (Nagendra & Gokhale, 2008; Sikor et al., 2017).

There has been increasing pressure on the Kenyan Government to protect natural forests as the forest resource is degraded (Wass, 1995). Between 1990 and 2015, forest land decreased by 311,000 Ha (GoK, 2016a). According to the National Forest programme, there has been a recent increase in forest cover from 6.01% in 2000 to 7.46% in 2015 (GoK, 2016a). The increased forest cover is mainly the result of on-farm tree-growing farms, while natural forests remain highly threatened (GoK, 2016a). This study was to determine the impact (positively or negatively) of forest governance on forest conservation under the three management regimes; exclusive community management in Loita Community Forest (LCF), referred to as the Community Regime (CR); a Command and Control or the Government Regime (GR) in Kakamega Forest National Reserve (KFNR) also called Buyangu and Participatory Forest Management Regime (PFM-R) in Kakamega Forest Reserve (KFR) also called Isecheno station.

2. Methodology

2.1. Study Area

The study was carried out in the Loita community forest and Kakamega forest (Figure 1). Kakamega forest is under two management regimes; strict government command and control management regime and joint community and government management under Participatory Forest Management Regime. These sites provided an opportunity to analyse and compare forest condition change of three different forest governance regimes.

2.1.1. Description of Loita Community Forest

Loita community forest, also called *Entim e Naimina Enkiyio* Forest which means “the forest of the lost child,” is located in Narok County, Loita Sub-County, and is estimated to cover an area of 33,000 hectares. The forest is surrounded by pastoralists who are fast shifting to a sedentary lifestyle by taking up crop farming with those living inside the forest increasing. The forest is an un-gazetted Community forest (Trust land) which the local people manage (Karanja et al., 2002; Riamit, 2011; Mbuvi et al., 2015) that has changed to Community Land (GoK, 2013; GoK, 2016c). The forest has never been under government centralised management process, and the community exercises the complete expanded bundle of rights (RRI, 2012). The forest has started facing degradation in 2013 through settlements,

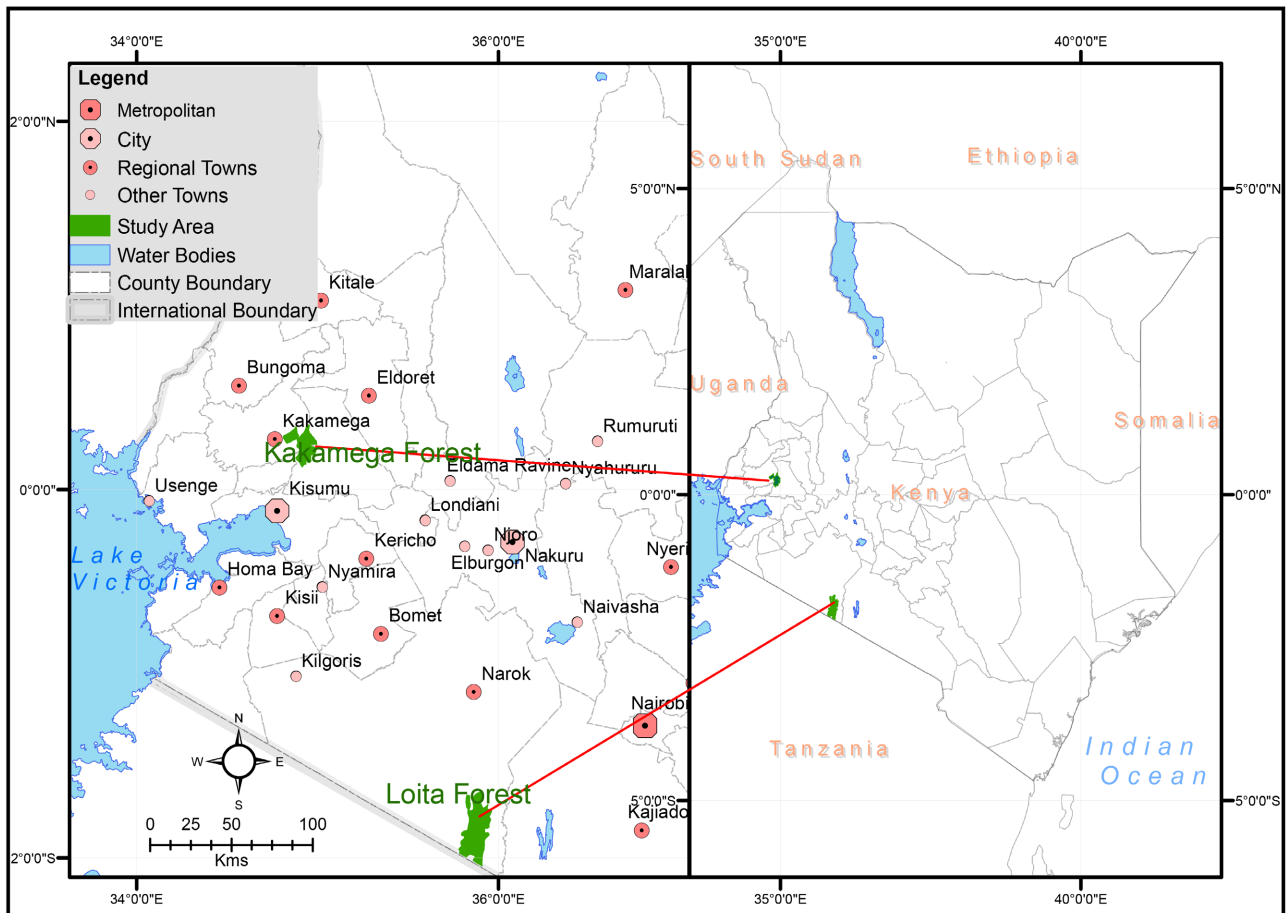


Figure 1. Location of the two study sites in Kenya (Data source: KFS).

tourist campsites, grazing in the forest, which was occurring all year round, extensive timber splitting was evident, and motorable roads crisscrossed the entire forest (Mbuvi et al., 2015). These challenges were hardly noticeable in 1999 because human impacts were limited and confined to settled areas, as noted by Kiyiapi (1999) and observed by Mbuvi et al. (2015).

2.1.2. Description of Kakamega Forest

Kakamega forest is the only remaining equatorial rain forest in Kenya that was first gazetted as Trust Land Forest under proclamation No. 14 in 1933 and has since been managed by KFS (Bleher et al., 2006). Kakamega forest is composed of indigenous forest cover and plantations (Kenea, 2008). Kakamega forest is an important global conservation area due to its rich biodiversity, and in 1995, IUCN ranked the forest as the third-highest priority for conservation among Kenyan forests (Guthiga 2007; Kenya Forest Service and Kenya Wildlife Service, 2012). Kakamega forest structure and composition have been affected by present and past anthropogenic disturbance. Most of the Kakamega forest is a middle-aged forest with some parts having young successional vegetation (Althof, 2005, as cited in Dalitz et al., 2011; Kenya Forest Service and Kenya Wildlife Service, 2012). For instance, much of the forest area under GR (Buyangu) is characterised by very young secondary

forest (Mitchell et al., 2009; BIOTA East Africa, 2004, as cited in Kenea, 2008; Muller, 2007, as cited in Maithya, Wuenscher, & Pahl-Wostl, 2009). The forest has experienced a long history of logging, fragmentation, and other anthropogenic disturbances, with forest cover having reduced by at least 52% since 1933 (BIOTA East Africa, 2004, as cited in Kenea, 2008). Further, the forest lost about 8% of the forest cover (1960 ha) between 1972 and 1976 (Mitchell, 2004, as cited in Kenea (2008) due to commercial forest operations, farmland expansion, overexploitation by local communities, gold prospecting, and later declarations and excisions. The forest adjacent farmers are involved in subsistence farming with bi-annual cultivation of a maize and bean intercrop, and they also invest in the commercial crops for cash revenues (Schaab et al., 2010).

The forest has undergone five main management phases. The earliest phase was when the forest was under local community management, as indicated by Kenea (2008). This phase was followed by government-led management in 1931, where the forest was placed under KFS (then Forest Department) management. The third phase was from 1959 and 1964 where the local people had access to some forest resources. The fourth stage started with the declaration of the forest as a central government forest in 1964. A fifth phase is now evident since The FCM Act, 2016, which allowed for the start of community participation through PFM (KFS, 2015a). The forest is composed of two forest blocks, each managed under a different regime (Figure 2); complete Government control; GR and joint (between government and community) forest management through PFM (PFM-R). The area currently under KFS is about 19,792.4 ha, while the KFNR under KWS management is about 4400 ha. The latter was declared a forest national reserve and gazetted as Kakamega Forest National Reserve (KFNR) under the management of KWS (Bleher et al., 2006) in 1985.

The Kakamega Forest National Reserve is located in the northern part of the forest, also known as the Buyangu area, which KWS manages. The community is strictly excluded and represents an area under strict centralised government management. Kakamega Forest Reserve is a gazetted forest reserve managed by KFS but under joint management between KFS, the community, and other stakeholders representing decentralized forest management (Kariuki 2008; Kenya Forest Service and Kenya Wildlife Service, 2012); in this forest block community participates in decision-making, livelihood activities like butterfly and silk moth farming, eco-tourism, and beekeeping.

2.1.3. Research Design and Data Collection Methods

The study used qualitative and quantitative research methodologies to collect social and ecological and land use and land cover changes. The qualitative methods included literature review, review of policy and project documents, household surveys, focus group discussion, questionnaires administered to key informants, and participant observation. Quantitative methods were used to determine forest land use, land cover, and forest structure change were done by analysing remote sensing data, forest inventories through transects, Geographical

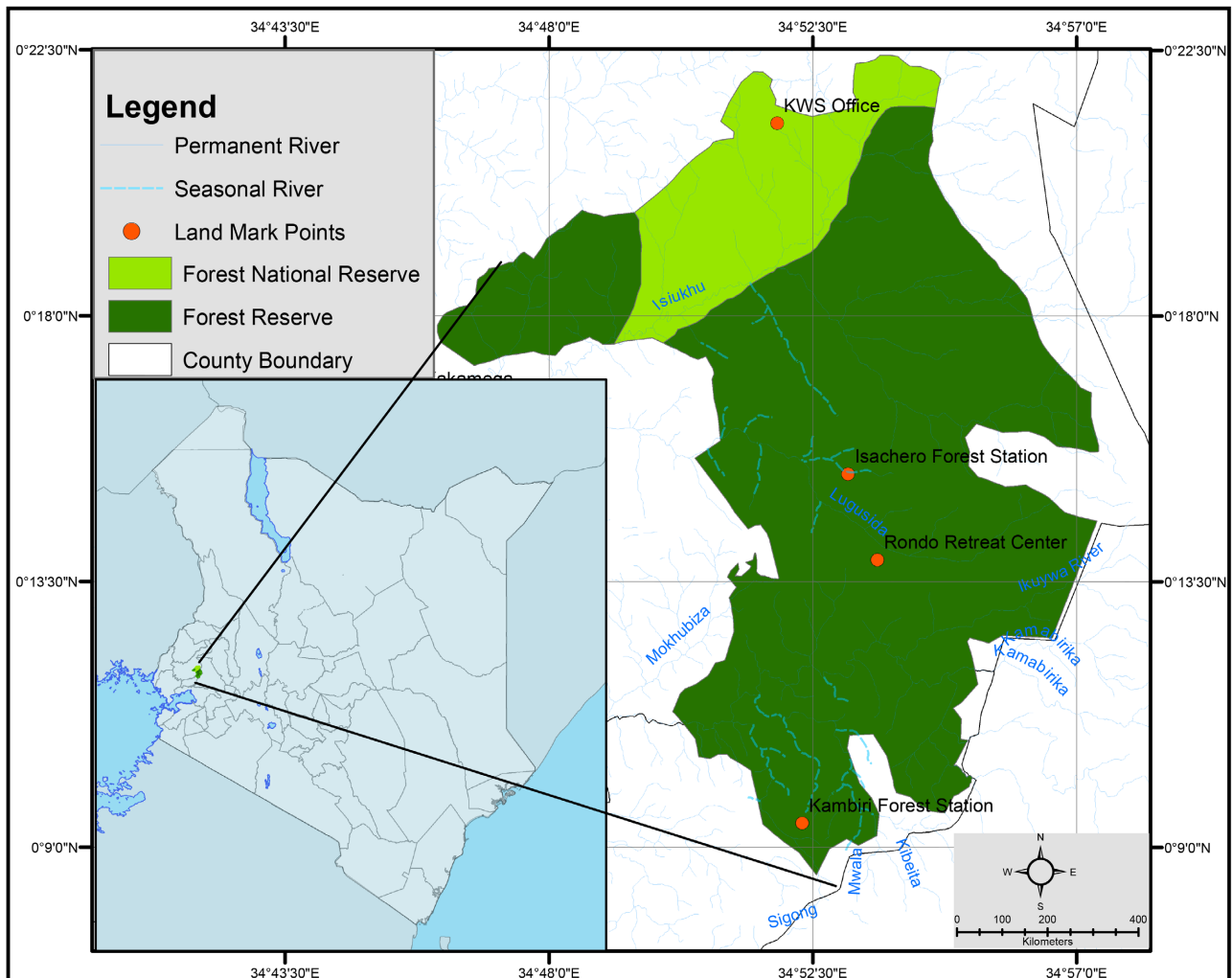


Figure 2. Location of Kakamega forest (Data source: International Livestock Research Institute (ILRI) Mapped by Ngugi Kigomo-KEFRI).

Information System and Remote Sensing and detailed household questionnaires.

In the PFM-R, households were clustered in three zones, namely Virhembe, Ileho, and Ikuywa. Ecological and land use and cover change were collected from forest areas adjacent to these zones. The ecological zones were; Virhembe, a zone composed of villages next to the Isecheno forest station and had had the longest interaction with KFS and external donor support leading to the households having benefited most from forest-related activities as PFM had been implemented the longest and has several Income-Generating Activities (IGAs), Ileho, was a zone that was farthest from the forest station, was accessing the most negligible KFS interaction and support from the projects but was anticipated to be having highest informal access of the forest and Ikuywa zone that zone was located between Virhembe and Ileho zones and was anticipated to have been accessing moderate KFS and project interaction it was accessing minimal benefits from initiatives like PFM.

In the community regime, household perception data were collected from six

study zones. The zones included; Entasikira village that is located less than a kilometre from the western forest edge, being the oldest settlement and largest shopping centre, it houses the sub-county headquarters, KWS outpost, a carpentry shop, a secondary and primary school, several churches, several shops and a hospital; Olorte is a small farming settlement about one kilometre from the forest edge with a fast-developing shopping centre to the South-West of the forest with a campsite, very active community Water Resource Users Association (WRUA), an NGO office and a private primary school. Additionally, Olorte has the most expansive Maize and vegetable growing area; Ilkerin is a rural development centre located over 20 km away to the West of the forest and has the largest shopping centre, a dispensary, a church, a livestock improvement project including offices for an NGO that has been coordinating development activities in Loita since 1972 but plans for its formation started in 1968. Areas adjacent to Ilkerin are not suitable for Maize growing, and the community graze livestock in the forest. Empururia zone is a fast-growing settlement area around a swamp in the middle of the forest and has three primary schools and churches. Ilmaral zone is a settlement that is about 15 km from the forest edge (towards the West). It has communities relying on the forest for grazing and Maize cultivation resulting to land degradation. Nkopon zone is located about 15 km South-West of LCF, the community practices Maize growing and livestock keeping leading to severe land degradation. The study zones are graphically shown in **Figure 3**.

The Key Informants (KIs) were used as a key approach in data collection. The KIs were selected through a snow-balling approach (Mugenda & Mugenda, 2003) whereby interviewees were asked to propose further KIs they considered to have relevant experience, and these were added to the sample until no new names were mentioned. Sixteen KIs were held spread evenly across the three sites. Group Discussion (FGD) were done through meetings that presented characteristics defined as per size, composition, and interview procedures as defined by Freitas et al. (1998). Five FGDs of mixed sexes and ages consisting of five and ten participants and selected with the help of KIs were initially held in each site (regime) (Freitas et al., 1998; Folch-Lyon & Trost, 1981; Boateng, 2012). The FGD were used to discuss complex trends on; forest land use and land cover change trends as observed by Folch-Lyon & Trost (1981), forest governance regime dynamics over time, forest canopy status (open or closed), the social and environmental impacts, the presence of key indigenous tree species, the occurrence of cut trees and how the participants perceived any changes to be attributable to the governance regime.

2.1.4. Natural Science Methods

This involved assessing the change of forest condition over time to quantify the impact of different approaches on forest Management (Kimutai & Watanabe, 2016). Forest condition was assessed from species diversity indices, forest disturbance trends, and forest structure indicators such as size/age distribution, density,

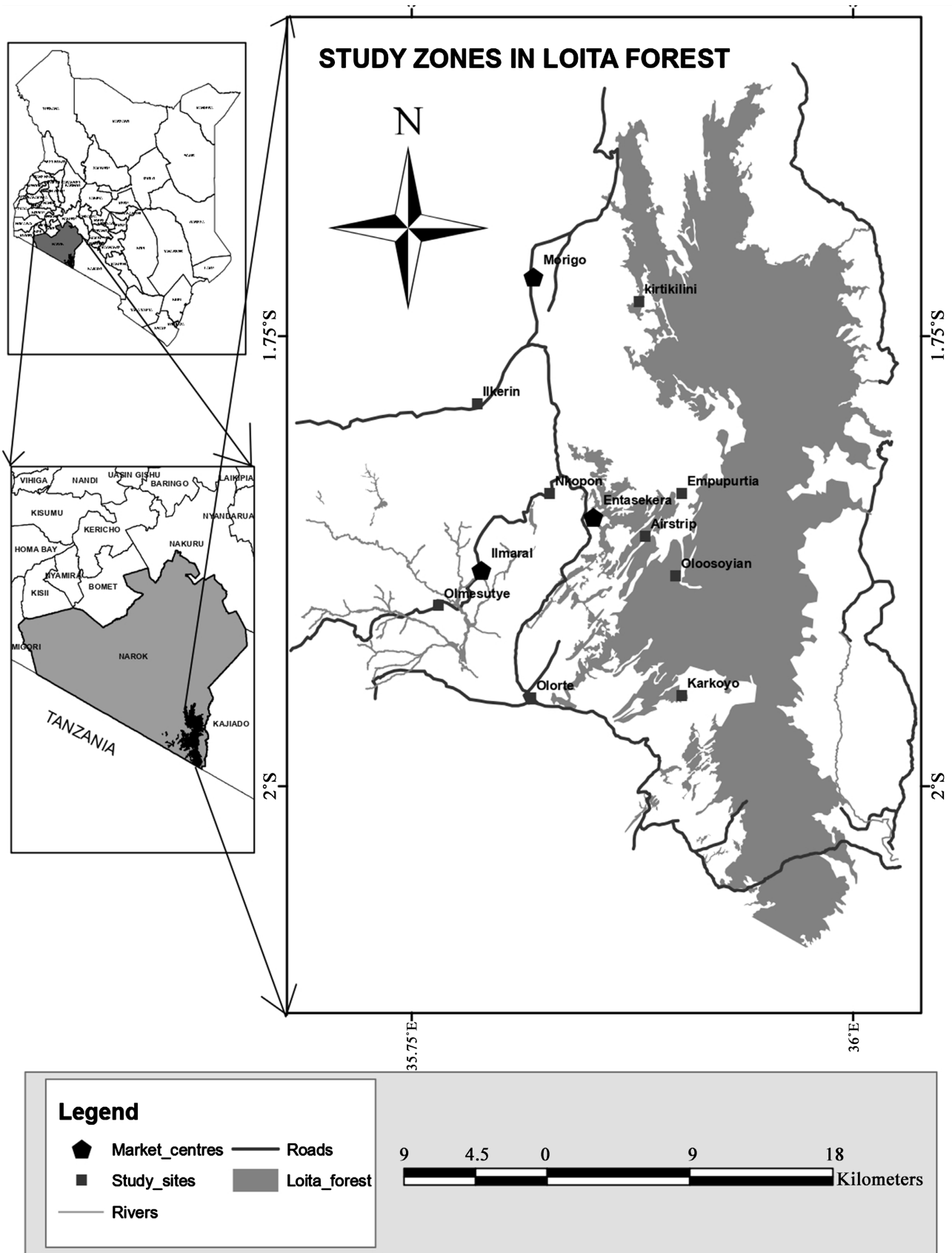


Figure 3. Study zones in Loita forest (Data source: KFS).

canopy cover, and patch-fragmentation (Yin et al., 2014). Forest resource assessment to determine each forest governance regime's impact on conservation was done through belt transects of 100×20 m. In Kakamega Forest, transects were established in both primary and secondary forests running from the forest's edge towards the interior. Existing forest maps were used in the identification of primary and secondary forest blocks. The KFR was divided into five zones. Isecheno zone was sub zoned into Primary (P) and Secondary (S) forests. The zones included; Chelovani (P), Ikuywa (P), Ileho (P), Lirhanda (P) and Isecheno both (P and S) (Figure 4). For Loita, the entire forest was classified as primary forest and transects randomly established from the edge to the forest's interior. The number of transects and plots established in each forest site was proportional to the forest site's size (Kindt & Coe, 2005). The transects were done as follows; twenty-four transects in the PFM-R, twenty-nine in the GR, with sixty-one being done in the CR.

In each transect, sampling plots measuring 20×20 m were systematically established at an interval of 50 m for enumeration of all tree and shrub species with a height ≥ 1 m. The species were identified, and diameter measurements were taken at breast height (1.3 m above ground) for trees with DBH ≥ 2.5 cm. Also, the height of each tree and shrub was measured. Also, within each 20.0×20.0 m plot, three 3.0×3.0 m sub-plots were randomly nested for counting the regenerates as defined in Kenya Forestry Research Institute (2016). The counted regenerates were identified by species. The parameters assessed included: regeneration rate, species abundance, frequency, diameter size class distribution and density. These were used to make inferences on the condition of the forests under different management regimes. Changes in Loita's forest conditions were explained through KI and FGD because of the absence of a baseline ecological study.

The land cover change was done through geographical information systems and used classes of; thick forest, light forest, grassland and bare land (Anderson et al., 1976; Siderelis & Nagy, 1994). Each area's percentage cover was calculated for each vegetation type out of the total area and was done for three periods of 1990, 2000 and 2012. This was supported by community defined forest condition classification. In Loita forest, vegetation change and land cover analysis looked at forest land cover change around three defined zones. The zones were: Oloosoyian (A) area where settlements were starting; Korkoyo (B) area of forest which was hardly settled and farmed but heavily grazed almost throughout the year; and Olorte (C) forest area, which was adjacent to a rapidly growing farming settlement practising irrigated farming.

In the Kakamega forest, forest area changes were detected through canopy analysis and reduction of forest area and or boundary changes over time. The forest land cover change was done for the whole forest block and each management regime. In the PFM -R, detailed imagery was done for Virhembe, a section of forest near the forest station offices, in a forest area adjacent to Ileho, which is far away from the forest station hence poorly policed and Ikuywa, which is an

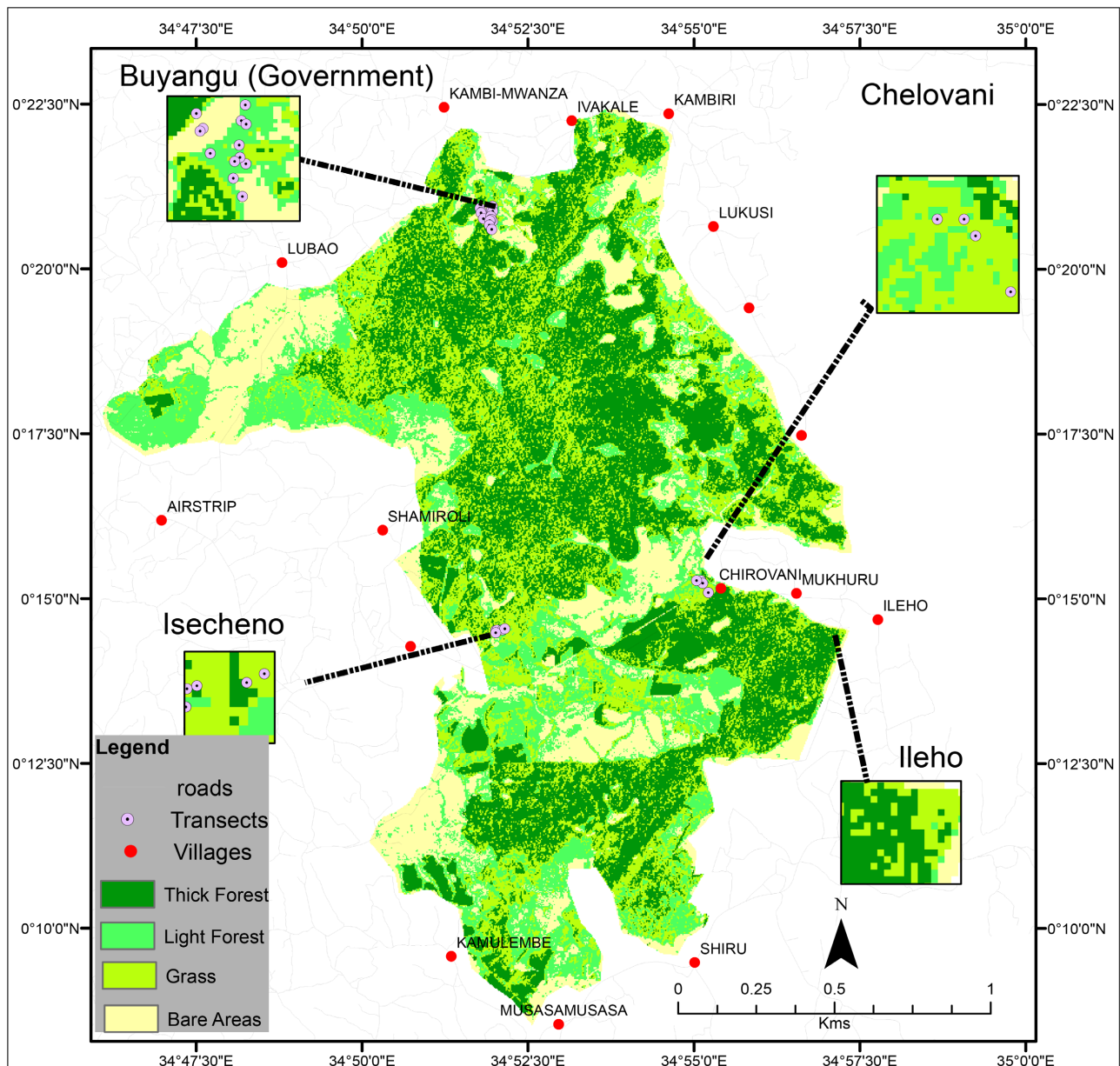


Figure 4. Location of ecological and socio-economic study zones in Kakamega.

area between Chelovani and Ileho and is moderately policed. The GR was treated as one site due to a uniform management approach. The forest condition was determined from forest extent (size—spatial) and forest quality change over time. Forest extent was determined from forest area loss due to deforestation, excision, or encroachment, including forest area gain from tree planting and fragmentation analysis of the GIS images over 30 years, with images available for 1990, 2000 and 2012. Forest quality was assessed through change over forest degradation time in terms of species diversity, structure (basal area), stand density and regeneration. The current forest condition was compared with previous resource inventory reports to determine changes over time. FGD were held to discuss the significant causes of the degradation.

2.1.5. Data Analysis

Household data on perception was done using excel and presented in bars and graphs. Changes in forest resources based on Landsat images/remote sensing were analysed using time series analysis procedure to detect forest cover change over time under different management regimes. Satellite images through land cover change fragmentation analysis using four clusters analysis provided forest condition (size and quality) trend over the last 30 years in terms of forest land cover change to determine the extent of habitat fragmentation (degradation) and loss within the forest (Chapungu et al., 2014). The vegetation data analysis to determine the forest governance regime's effect on forest conservation was done using four parameters; thick forest, light forest, grass and bare land in each of the governance regimes. The measure of diversity used was the Shannon-Wiener diversity index (Shannon & Wiener, 1963; Krebs, 1999).

3. Results and Discussions

3.1. Respondents Views on Forest Governance Regimes in Kenya's Forestry Sector

The study sites were under three management regimes; community alone, government alone and community and government managing jointly under PFM. In the Loita forest, community management was considered the main management approach by the household respondents where 56% perceived the Council of Elders to be the managers, 17% and 6% indicating community and KFS respectively, while 21% were not aware of the manager. Communities have exclusive rights to manage and exclude others. The households in the GR indicated that the Government was the lead agency in managing KNFR (62%); Government and community were perceived by 32.4%; community by 4.2% of the household respondents while 1.4% were not sure of the lead agency. Community elders were not perceived to have any role.

The management approach being applied in the GR was Command and Control (93%), while a small proportion (7%) of the respondents felt that they were involved in forest management. Additionally, the households indicated the key management organisation contributing to better forest management was the Government (38%). The other factors that were mentioned to have contributed to better management of forest were the community (14%), PELIS (15%), KFS (14%), joint forest management (community and Government) 7%, with 6% not being sure. The indication that communities in the GR were practising PELIS was an indication that the households could be accessing it through those communities adjacent to KFR (PFM-R) where it is practised. In the PFM-R, it was indicated by 63.9% of the households' respondents that Government and community were contributing to better forest management, with 23.3% mentioning government; the community was mentioned by 10.6% of the respondents and 2.2% of the respondents not being sure. These findings confirm that the community and Government are not enjoying exclusive management rights in the three

study sites.

3.2. Vegetation Change and Land Use Cover Change Analysis and Ecological Assessment

Land use cover change provides details on the destruction of habitats, isolation of fragments of formally contiguous habitats and edge effects as discussed below.

Fragmentation Analysis in Community Regime

There was less forest degradation from 1990 to 2000 but forest condition degraded in all three study zones between 2000 and 2010 with thick forest in Olosoyian (A) reducing from 62% to 48% (Figure 5). Focus Group Discussion attributed thick forest reduction between 2000 and 2010 to increased construction due to the increased settlement in the forest and demand for building materials by adjacent settlements of Ilkerin, Olorte, Olmesutie, Ilmaral, Morijo and Nkopon and the households inside the forest. Olorte (C) had witnessed the highest reduction in land area under grass from 72.1% to 6.7% between 1990 and 2010. This change was attributed to the clearing of farming areas under irrigation and expanding maize farming and livestock (sheep) grazing. The slight increase in thick forest status in Olorte over the years from 1990 to 2010 was attributed by FGD to extensive settlement, farming and shifting from livestock keeping to Maize growing which has also forced the households to keep their livestock away from their farms to minimise animals straying into their Maize plantations. All the glades in the forest are being converted to farms, homesteads and bare areas. In Korkoyo (B), a similar trend was witnessed, with thick forest reducing from 74% to 56% within the same period. FGD attributed the changes to drought in 2004, where Loitans from Tanzania brought their livestock to Kenya, leading to overgrazing in the forest where tree branches were lopped to feed livestock.

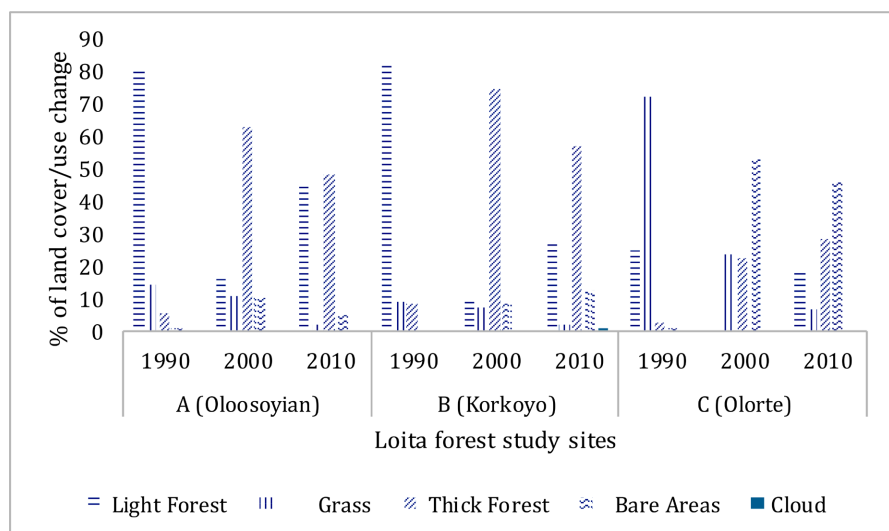


Figure 5. Forest land-use change analysis for Loita forest study zones.

The Loita forest thick forest area land cover change was oscillating between 6% in 1990, 62% in 2000 and 49% in 2010. This frequent land cover change could reflect instability in community control and failure to impose modern management procedures that have allowed timber cutting and settlement in the forest. These prevailing changes were predicted by Kiyapi (1999) that as the population of the adjacent communities' rises and infrastructural development starts in the area, demand for forest products is likely to go up, creating threats to the forest ecosystem.

Participant observation, KI and FGD during this survey indicated forest and forest land-use change were happening as a result of people settling in the forest, including the construction of schools, farming being allowed, homesteads coming up, vegetables growing in the wetlands and swamps through draining and construction of churches especially around the largest swamp in the forest as the situation called "grounding claims" by García (2015). These changes were evident around the largest swamp in the forest, Esere Empupurtia, where KII indicated that the number of households increased from one in 2007 to over eighty households in 2011 and timber splitting was happening in the whole forest. The Oloi-bon underscored the importance of developing a management plan, capacity building and awareness creation as the most appropriate tool to facilitate the sustainable management of LCF.

Loita forest extent (size) and quality were indicated by the communities (FGD) to have been reducing since 1990 because of communities settling down, clearing forest areas next to their homesteads for crop farming, and constructing livestock kraals. Forest areas away from (Korkoyo) homesteads were more intact and were used for grazing, timber and medicine. This scenario was collaborated by an ecological survey (Figures 6(a)-(d) and Table 1). The area far away from major settlements like Mause section of the forest had a big diameter of individual valuable tree species like *Podocarpus falcatus* Mirb (DBH 174 cm) and fewer trees of lower DBH. The areas were experiencing low regeneration as the vegetation was at the climax stage and was under intense grazing. In Entasikira, the bigger trees were of low timber value, *Ficus thonningii* BI (DBH 188 cm). The area was also experiencing fewer disturbances because of the national Government's presence, especially the chief, Assistant County Commissioner and KWS rangers.

Further, forest areas near settlement had high-value tree species cut, and evidence of a past disturbance was associated with a high regeneration rate. Kirtilikini forest zone is adjacent to Morijo town, faced degradation due to settlement, rapidly expanding Maize farms and tree cutting that targeted trees of diameter between 25 cm and 50 cm. Further, as Banana et al. (1999) noted, this could be because of a lack of interest and motivation of the community scouts who are volunteers with no tangible benefit accruing to them. This status was confirmed during FGD and attributed to households and married members of households establishing new homesteads in the forest. Though in 1999, the main

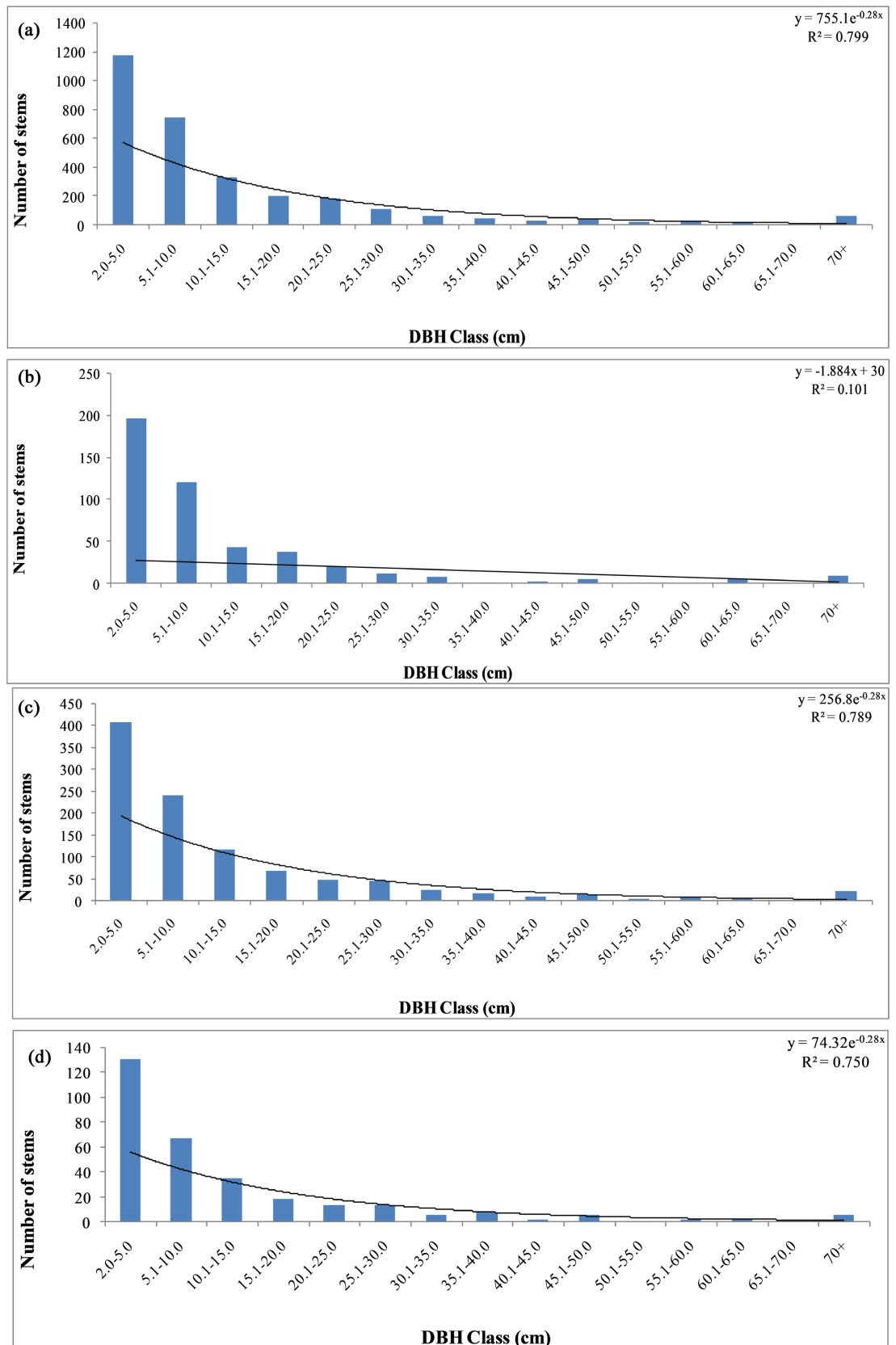


Figure 6. (a) Diameter class distribution of Loita in General; (b) Diameter class distribution in Kirtikilini; (c) Diameter class distribution in Entasikira; (d) Diameter class distribution in Maua.

Table 1. Ecological characteristics of Loita forest.

Forest zone	Oloosoyian	Swamp	Korkoyo	Entasikira	Kirtilikini	Mausa	Oloeni	LSD	P-value
BA/ha (m ² ·ha ⁻¹)	31.32 ± 1.7	52.1 ± 1.4	80.87 ± 1.7	52.06 ± 1.1	68.07 ± 1.6	53.32 ± 1.8	80.76 ± 2.0	54.11	0.460
Stems per hectare	1154 ± 149.2	1312 ± 146.7	1262 ± 72.5	1193 ± 94.0	1453 ± 167.7	1580 ± 301.4	1131 ± 98.6	509.5	0.538
Saplings/ha	8981 ± 3126.0	2947 ± 343.2	8181 ± 4054.0	2255 ± 477.2	2996 ± 699.8	2760 ± 433.7	4176 ± 1657.0	3786	0.002
Seedlings/ha	8012 ± 1856.0	9562 ± 1274.0	11,186 ± 3114.0	6129 ± 625.1	8866 ± 1432.0	14,204 ± 2726.0	9041 ± 2951.0	5342	0.014
Diversity (H')	3.2 ± 0.02	2.9 ± 0.02	3.4 ± 0.03	3.8 ± 0.03	3.2 ± 0.01	3.1 ± 0.02	3.0 ± 0.16	0.1881	0.001
Height (m)	9.4 ± 0.6	20.5 ± 1.3	10 ± 1.0	9.0 ± 0.4	13.0 ± 1.3	16.8 ± 1.5	10.9 ± 0.8	2.89	0.001
DBH (cm)	14.4 ± 1.4	16.8 ± 1.7	15.6 ± 2.8	14.3 ± 1.2	11.59 ± 1.3	14.5 ± 1.5	15.1 ± 1.8	2.43	0.44

forms of disturbance were wildlife and human with anthropogenic impacts being limited and confined to the settled area (Kiyiapi, 1999), this scenario was changing as field observations, and FGDs during this study (2012 and 2016) showed that forest degradation drivers had expanded to include logging, farming of cereals and vegetables, construction of shopping centres and schools inside the forest due to increasing population and changing land use and lifestyles.

Additionally, the forest may have remained more or less the same ecologically. The condition at seven zones in Loita forest, as outlined in Table 1, points to a forest facing degradation in some zones. According to forest stocking, the basal area based on sampled plots in this study was >80 m²·ha⁻¹ for the closed-canopy forest in Korkoyo and Oloeni. A forest with a basal area > 70 m²·ha⁻¹ is usually classified to be in good condition. Though the impact of forest degradation may not be noticeable as the forest was still in very good condition with big trees, closed canopy and high regeneration, the impact though maybe bigger because of uncontrolled grazing, farming and settlement in the forest, may limit regeneration. During this study, the forest had the same basal area of 80 m²·ha⁻¹ in Korkoyo and Oloeni, which are areas with closed-canopy forest with the basal area reducing to 31 m²·ha⁻¹ and 53 m²·ha⁻¹ in open-canopy forest areas of Oloosoyian, the area around the swamp, and Entasikira which were under increased pressure from the settlement, farming and urbanisation.

The forest was highly disturbed in Entasikira, Swamp (Empupurtia), and Oloosoyian based on seedling density and basal area. Entasikira is adjacent to the largest urban settlement in the CR, while the swamp is the fastest-growing settlement and farming area inside the forest. Korkoyo, Oloeni and Kirtilikini were the least disturbed as they are not settled, but they are only affected by grazing and occasional timber and pole cutting. Forest regeneration was seriously affected by grazing, mainly by sheep, goats and donkeys. Grazing was more rampant in Entasikira, Oloosoyian and around the swamp. Mausaa and Korkoyo were least affected as they are far away from the settlement, farming was not allowed by the traditional authorities

and grazing was not done intensively. The grazing of sheep, goats and donkeys was having a negative effect on Entasikira and Oloosoyian. According to Kiyiapi (1999) and the present study, most tree species in the Loita community forest are represented in all size classes (reversed j-shaped distribution).

3.3. Fragmentation Analysis (Land Cover Change Analysis) and Ecological Assessment for Government and PFM Regime (Kakamega Forest)

Fragmentation analysis of satellite images from 1990 to 2011 for the entire Kakamega forest (KFR and KFNR) showed an increase in fragmentation (particularly in the 2000-2011 period) and a general shift from thick to a light forest (Figure 7). The thick forest reduced from 61.3% of the total area in 1990 to 53.0% in 2011, with a marked reduction being witnessed between 2000 and 2011. The light forest section's increase was gradual, but the grass area reduced mainly due to planting through PELIS and re-forestation of glades in the forest. The most notable causes were the forest's excising to pave the way for establishing the Kakamega showground and construction of the prison. The Kakamega (GR and PFM-R) forest edge suffered more degradation over the 20 years, indicating poor policing and encroachment on forest boundaries through grazing and farming. This status may indicate that the whole forest is not being uniformly protected. This situation could be attributed to poor policing and high population pressure, keeping of livestock, reducing household landholding units and unclear boundaries between the forest and the community.

The forest exhibited a varied level of degradation, with the GR in Kakamega forest where C and C was being applied exhibiting the least disturbance and high regeneration common in the primary zone of the forest where there was better protection in Kakamega forest. The primary section in the GR in Kakamega forest witnessed an increase in the dense forest from 33% to 44.6%. This trend conforms to Muller & Mburu (2009) observations that natural forest clearing was detected across most Kakamega Forest, with clearing clusters in the southern part and at the edges of the natural forest blocks with higher clearing being observed in less strictly protected forest areas. This ecological trend was similar to the study by Lund et al. (2015) in Kiwele and Mfyome forests in Tanzania, where the disturbed area of Mfyome forest reduced between 1999 and 2001 in areas near the main village, but disturbance increased in remote parts far away. Ecological and GIS-based studies (Lung & Schaab, 2006, as cited in Guthiga, 2007) have shown that the forest area in KFR (PFM-R) was more disturbed than KNFR (GR) section. Guthiga (2007) indicated that the main challenge facing the PFM-R was poor enforcement due to inadequate budgets, human resources and patrol vehicles to cover the whole forest. However, the scenario had changed by 2012 as KFR (PFM-R) was manned by three vehicles, and the patrol capacity had increased with well trained and armed forest rangers. More resources could have contributed to an increase in thick forest noted between 1990 and 2011.

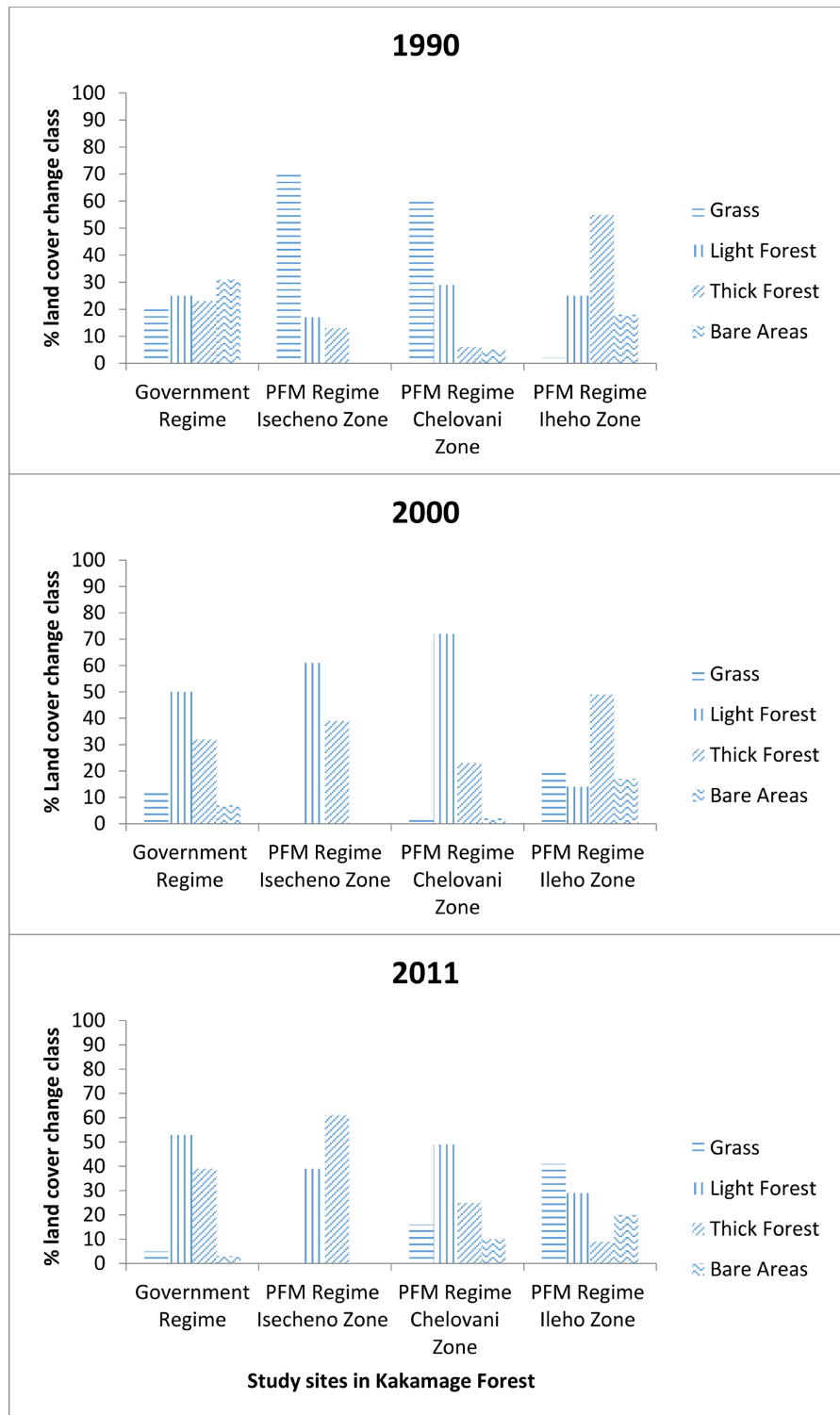


Figure 7. Fragmentation analysis of Kakamega forest area (government and PFM Regime).

Land cover class change percentage for four zones in Kakamega forest provided a more detailed analysis. The zones included a GR and three zones zone in the PFM-R, including Isecheno (close to the forest station), Chelovani and Ileho. The light forest in Isecheno increased from 17% to 39% between 1990 and 2011,

with the same period witnessing thick forest increase from 13% to 61% (Figure 7). The increase in light forest in 2000 was due to tree planting and stakeholder involvement in forest management that led to tree planting and reduction of grass areas. This led to the increase in thick forest in 2011. These increases in forest cover and reduced area under grass could be attributed to stakeholders' involvement, especially communities who are accessing benefits formally and their participation in tree planting. Most of these benefits have been derived from PFM related initiatives like beekeeping and butterfly farming. The grassland has been reducing, and by 2010 it had been replaced by other land uses such as tree planting, crop farming and settlement.

In the Chelovani area, which is located far away from the stations and forest ranger outposts, the bare area increased from 5% to 10% between 1990 and 2011. The area witnessed an improvement in the thick forest from 6% to 25%. The Chelovani area also shows an increase in light forest areas over the 20 years from 29% to 49% and a drastic reduction of the area under grass from 60% to 16%. Ileho, which is the least policed area, witnessed a reduction in the thick forest from 55% to 9% at the same time as an increase in the light forest from 25% to 29% and in the area under grass from 2% to 41% within the same period. The increase in the light forest was indicated to have been caused by cutting trees due to poaching and grazing due to poor policing, a status reported by the *Ministry of Forestry and Wildlife (2013)* and confirmed by KI during the survey.

Ileho area located far away from the Isecheno forest station showed an increase of both bare and grass areas though the area under grass reduced between 1990 and 2000 but witnessed a drastic increase between 2000 and 2011. The area experienced a reduction in the light forest, with the thick forest increasing between 2000 and 2011. The increase was attributable to degradation from encroachment and grazing as the area is far away from the station. This trend conforms to *Muller & Mburu (2009)*'s observation that higher clearing rates were observed in the less strictly protected Forest Reserves than in the more strictly protected National Reserves. The situation in KFR conforms to the principle of conservation where the conservator of forests is concerned about posterity but appreciates that humanity would require timber. At the same time, the preserver (KFNR) hopes to keep large areas of the forest untouched by human hands, as indicated by *Passmore (1980)*, as cited in *Chebii (2015)*.

In the GR, both the light and thick forests have been increasing over the last 20 years, while grass and bare areas have declined. This increase is probably because the governance regime confers authority on KWS to manage the forest and makes them wholly responsible for developing and implementing the management plan and ensuring they have the requisite capacity for effective management. Decentralization through PFM seemed to be contributing to improved forest conditions and lower disturbance in the forest (*Blomley et al., 2008*, as cited in *Lund et al., 2015*). The PFM site also shows that better management was achieved in the forest zone near the Isecheno (PFM) station. Key Informant confirmed this, and during FGD, it was explained that proximity to the forest sta-

tion at Isecheno (PFM) meant that the area was under better KFS patrolling supplemented by community patrolling. Involvement in Income Generating Activities (IGAs) incentivised communities to protect the forest. Global experience of cases of PFM shows that PFM has a positive impact on rural livelihoods, governance and forest condition (Lawrence, 2007; Matiku et al., 2013; Mutune et al., 2017).

Vegetative Change Analysis for Government and PFM Regimes

In the PFM-R (KFR), the primary forest in Isecheno had the highest basal area ($82.18 \text{ m}^2\cdot\text{ha}^{-1}$) compared to Ikuywa ($30.71 \text{ m}^2\cdot\text{ha}^{-1}$). The bigger basal is because in Isecheno primary forest, there are huge relic trees with big diameters, while in Ikuywa, which is far away from the forest station, all big diameter trees have been cut/poached through illegal activities as it is less policed. Bleher et al. (2006) showed that the highest logging levels occur mainly in the southern part of the forest like at Ikuywa and along the Western edge, mainly at the Ileho area, which also happens to have a low basal area of $22.19 \text{ m}^2\cdot\text{ha}^{-1}$.

The forest has been under increasing pressure to provide products to the increasing population. Kuria et al. (2011) noted that there was enormous destruction of the Kakamega forest between 1986 and 1995, but the forest recovered substantially between 1995 and 2005. The forest recovery was attributed to reduced agricultural activities in the forest, projects supporting tree planting, empowerment of local people through community-based environmental protection approaches and increased forest plantations. Furthermore, Fashing et al. (2004) showed that stem density (for trees with a DBH of $\geq 2.5 \text{ cm}$) increased from 378.3 SPH in 1981 to 414.0 Stems Per Hectare (SPH) in 1999, while this study showed that SPH in 2012 was 715 for the primary forest in Isecheno section of KFR under the PFM-R; an increase of 72.7% which is significant (Table 2). This trend is an indication that the forest condition has been improving due to involvement (decentralising governance) of local communities in forest management and better forest management (Kuria et al., 2011). A similar trend was experienced in the Chemorgok Forest Block of Lembus forest, where an increase in the recovery was attributed to the reforestation programme by the CFA and natural regeneration

Table 2. Ecological characteristics of Kakamega forest reserve (PFM regime).

Attribute	Chelovani (P)	Ikuywa (P)	Ileho (S)	Lirhanda (P)	Isecheno (P)	Isecheno (S)	LSD	P-value
BA/ha ($\text{m}^2\cdot\text{ha}^{-1}$)	37.81 ± 0.5	30.71 ± 1.1	22.19 ± 0.5	49.62 ± 2.1	82.18 ± 1.8	46.28 ± 1.3	2.8	0.001
SPH	2175 ± 177.5	1158 ± 145.0	1258 ± 205.0	558 ± 205.0	715 ± 91.7	1000 ± 158.8	481.9	0.001
Saplings/ha	1391 ± 348.6	2056 ± 827.8	4203 ± 1927	2037 ± 449.8	2395 ± 183.1	1708 ± 430.6	2644	0.343
Seedlings/ha	1325 ± 231.4	2050 ± 351.9	2000 ± 491.4	1464 ± 219.1	2330 ± 167.4	2181 ± 572.0	1597	0.767
Diversity (H')	3.6 ± 0.006	3.6 ± 0.012	2.7 ± 0.012	2.6 ± 0.009	3.5 ± 0.035	2.9 ± 0.029	0.06	0.001
Height (m)	7.8 ± 0.5	8.9 ± 0.7	12.1 ± 1.0	17.6 ± 2.4	13.6 ± 0.7	9.9 ± 0.8	0.028	0.001
DBH(cm)	10.7 ± 1.0	12.6 ± 1.4	12.6 ± 1.4	23.3 ± 3.4	25.1 ± 1.7	16.9 ± 1.9	5.94	0.001

(Kimutai & Watanabe, 2016).

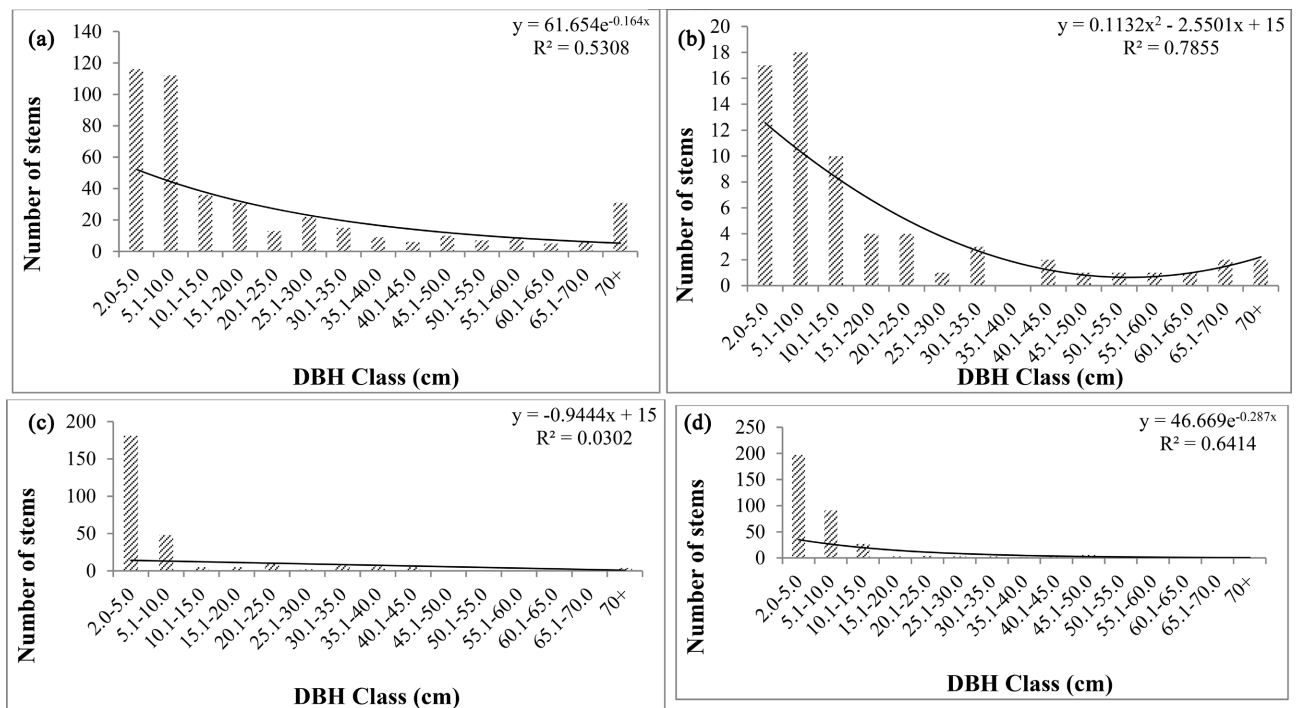
At the GR site, all forest attributes (except stem density) were significantly different (t-test, 95% confidence level) between primary and secondary forest (Table 3).

High regeneration was witnessed in the primary zone of PFM-R due to better protection and availability of mature seed trees. In Chelovani, low regeneration was witnessed due to grazing and cutting of seed trees. Diameter class distribution in the PFM-R forests and the forests' sections far away from the forest station demonstrated a reversed exponential curve having more trees of a lower diameter size class. This trend was an indication that although large-diameter class trees were being cut, the relic tree seeds encouraged regeneration. The forest section near the Isecheno and Lirhanda (Figures 8(a)-(d)) had trees with a diameter over 70 cm and had a normal distribution of the "inverse J" curve. Considering that Fashing et al. (2004) found the same distribution in 1981 and 1999, this suggests that the forest has maintained a size class distribution of a natural rain-forest over 33 years in areas/blocks with little or no disturbance. This status suggests that the forest condition had not been significantly affected by the intense population pressure (Fashing et al., 2004). This trend was an indication that the conservation efforts, especially through PFM, have been effective. This study showed the forest area under PFM had the highest basal area and DBH. Better conservation in Kakamega forest was attributed to the work done through several projects initiated in the region to enhance forest conservation in line with government policy of improving community livelihoods and forest management through participatory approaches (Kuria et al., 2011).

Households perceived the forest area near the Isecheno forest station in the PFM-R to have a closed forest canopy indicating low disturbance. This situation concurs with the ecological results of this study which show that the PFM-R (Isecheno) primary section of the forest had a stand density of 715 Stems Per Hectare (SPH) for trees with a DBH of ≥ 2.5 cm against a low SPH of 285 in Chelovani forest zone which is the farthest from the forest station. This disturbance trend suggests that PFM management was most effective closest to the forest station as was found by Lund et al. (2015) in Tanzania, where forest disturbance

Table 3. Ecological characteristics of Kakamega forest reserve (GR).

Attribute	Buyangu (primary)	Buyangu (secondary)	t-statistic	P-value
BA/ha ($\text{m}^2 \cdot \text{ha}^{-1}$)	31.32 ± 9.28	31.60 ± 2.61	2.27	0.264
Stems per hectare	799 ± 0.0	310 ± 0.0	10.86	0.001
Saplings/ha	2540 ± 394	1679 ± 117	12.1	0.001
Seedlings/ha	2018 ± 418	1500 ± 146	8.48	0.001
Diversity (H')	3.2 ± 0	2.9 ± 0	20.33	0.031
Height (m)	9.6 ± 0.4	12.2 ± 0.4	46.8	0.001
DBH (cm)	10.9 ± 0.7	9.5 ± 0.2	37.18	0.001



*The above figures show diameter class distribution of Kakamega forest reserve (Isecheno forest reserve)

Figure 8. (a) Diameter class distribution in Isecheno (primary); (b) Diameter class distribution in Lirhanda (primary); (c) Diameter class distribution in Ikuywa (primary); (d) Diameter class distribution in Chelovani (primary).

reduced in a forest area near the village while forest disturbance increased in more remote parts of Mfyome forest, and also in Uganda by [Banana et al. \(1999\)](#). In the CR, though the forest still had a closed canopy, it was being opened up in forest areas near settlements to give way for Maise and homesteads, leading to degradation. This study, therefore, affirms the call by [Muller & Mburu \(2009\)](#) that managers should give increased protection attention to areas far away from the station and forest edges.

3.4. Household Perception of Changes in Forest Condition (Size and Quality) between 1990 and 2010

The household respondents indicated a change in forest size over time, with respondents' opinions at the three sites being significantly different ($\chi^2 = 27.614$, $p < 0.001$). Respondents in the PFM-R and the GR felt that the forest size had reduced significantly, with 52% and 51.6% indicating that the forest size has reduced, respectively. In the CR, only 14.8% were of the opinion that the size had reduced. Interestingly, when asked about forest conditions, the majority of respondents in all three sites (52% in the PFM-R, 65% in the CR and 67% in the GR) perceived that the forest condition was better in 2011 than in the year 2000. Regarding forest conditions before 2000, the households in all the regimes felt that the forest condition was generally good, but 75% of the CR perceived that it was good ([Figure 9](#)). A very good forest condition was only indicated in the GR, while the PFM regime site had the largest number of households indicating a

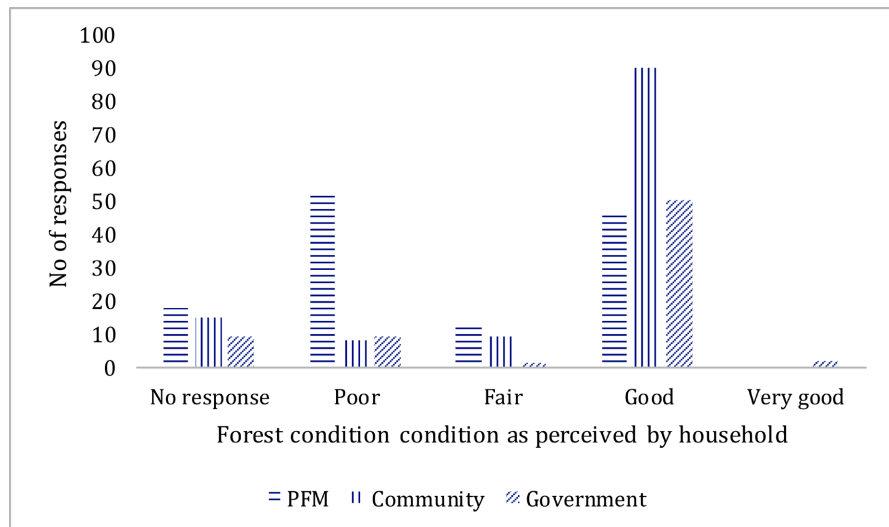


Figure 9. Forest condition before the year 2000 according to household respondents' perception.

poor forest condition.

The reduction in the forest area in the CR reflects what [Kiyiapi \(1999\)](#) predicted, that the community cannot simply argue that the forest has been well conserved in the past and therefore, this will continue. This status will not because of changes in critical socio-economic variables among the Loita Maasai and weakening Oloibon institution. Further, [Kiyiapi \(1999\)](#) advised the community to take more aggressive steps to safeguard their natural resources in the current socio-economic and political transformation.

Those respondents, who felt that the forest condition was worse before 2000, mentioned a range of causes. Illegal harvesting was cited to be a reason for worse forest conservation in the CR. Inadequate personnel was cited at both government and PFM regimes. They rely on employed government staff to manage the forest, not in the CR where volunteers are involved in forest conservation ([Figure 10](#)). Households indicated the population increase to be a major reason for worse forest conservation in the CR. This situation could be attributed to settlement in the forest. Corruption as a cause of worse forest conditions was more prominent in the GR, with respondents mentioning being allowed to graze livestock, collect firewood and cut poles after paying an inducement to the rangers.

3.5. Household Perceptions of Factors Leading to Better Forest Condition in 2011 than 2000

Respondents (63%) felt that forest conditions had improved from 2000 to 2011 across the three regimes. In the GR and PFM-R, this improvement was attributed to community involvement in forest management ([Figure 11](#)) and implementation of strict rules ([GoK, 2013](#); [GoK, 2016b](#); [Mutune et al., 2017](#)) and regulations, as was noted by [Mogoi et al. \(2012\)](#) for grazing rules in the Meru Forest Environmental Conservation and Protection (MEFECAP). Community involvement has been formalised through PFM, which has enabled the community

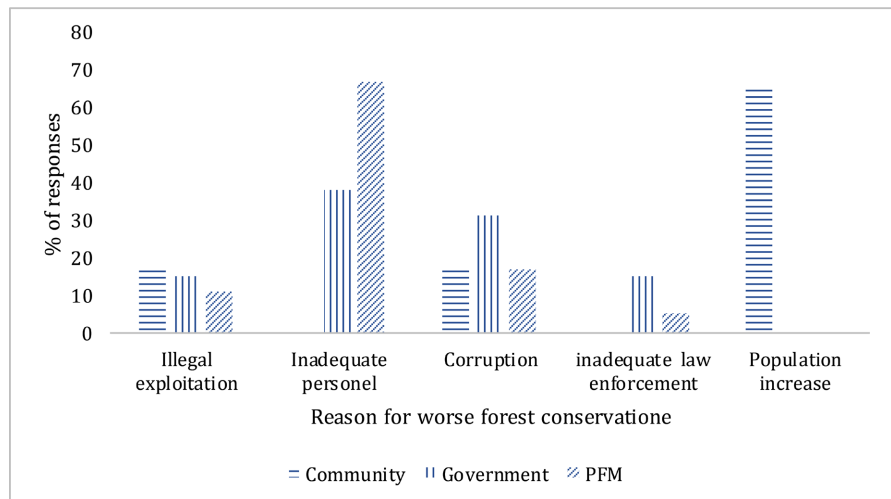


Figure 10. Household respondents' reasons for worse forest conservation in 2000.

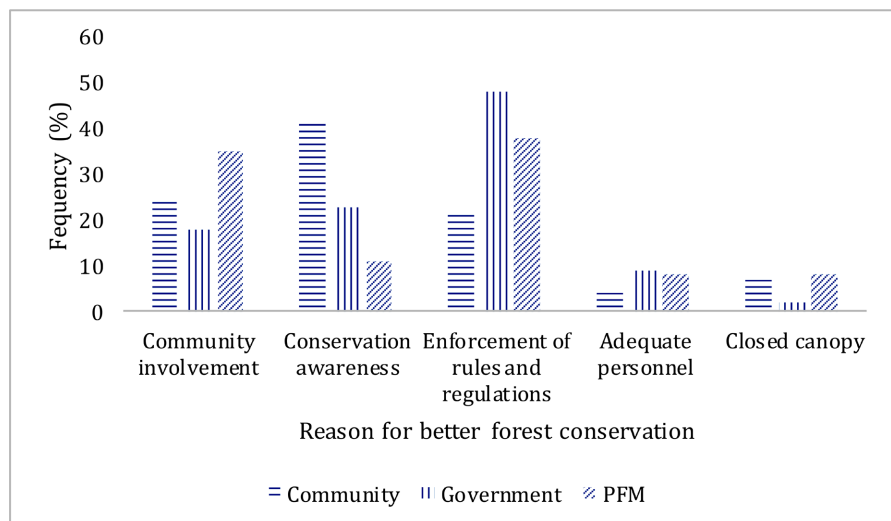


Figure 11. Reasons why the forest was in better condition in 2011 than in 2000.

and Government to manage the forest jointly. This partnership had been regulated through the formation of the Kakamega forest Community Forest Association that is regulated by its constitution and local guidelines, development of a Participatory Forest Management Plan (KFS, 2015a; KFS, 2015b; Chomba et al., 2015) and formalised through a Forest Management Agreement. The community scouts provide the required extra capacity, further contributing to improved enforcement of regulation leading to better-managed forests in the PFM-R, as was also found by Chomba et al. (2015). Conservation awareness was considered important in the community and the PFM regimes but mentioned by very few (4 respondents) in the GR. Adequate personnel and closed canopy were considered of lesser importance by the PFM-R, the community and the Government regimes households. The CR's high awareness would be attributed to Loita Maasai's view of the rangelands and the forest as one unit. The declaration of the Loita Sub-county where Loita forest is located is posing a threat to the Loitans communal ecosystem

utilization where the forest and the open rangelands are complementary and more beneficial when utilised as one ecosystem as noted by [Karanja et al. \(2002\)](#); MPIDO (2005), as cited in [Miner, 2011](#).

The households using community-based forest condition indicators indicated a great variation in forest condition among the regimes ([Figure 12](#)) between 2000 and 2010. The closed canopy was the most important indicator of forest conditions mentioned in all sites. The CR community perceived that the canopy was getting open as the majority (92%) of households perceived that the forest canopy was closed in 2000, but this declined to 64% in 2010. The forest condition was perceived to have remained the same in that period by respondents in the GR. In CR over the 1990-2010 period, the households did recognise a trend towards increasing canopy openness and more tree cutting. However, in Kakamega, the GR and the area close to the PFM-R (Isecheno forest) station in the PFM-R site indicated changes in forest quality varied by Regime and zones being viewed to have changed positively. The generally positive outlook in the GR forest may be explained because this area was under total protection, with non-extractive use permitted. In contrast, the CR was facing unprecedented utilization through settlement and logging. This trend was exacerbated by the weakening of the Oloi-bon and lack of partnership with KFS and County Government to provide support through technical, financial and human support, including rangers and community forest scouts.

“Cutting of trees” as an indicator for determining forest condition was not mentioned in the GR since it is not allowed. Although a small proportion of respondents mentioned it in the PFM-R, it occurred at lower levels in 2010 than in 2000, an indication of declining forest degradation and improved protection. In CR, “Cutting of trees” was more prevalent in 2010 than in 2000. Trees were being

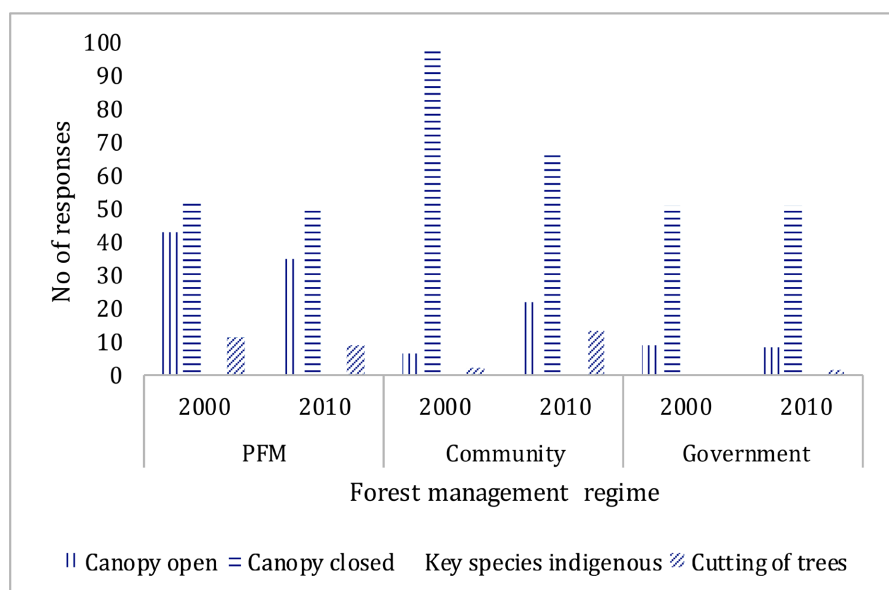


Figure 12. Household perceptions on the prevalence of forest condition indicators in 2000 and 2010.

cut to provide timber and space for agriculture, suggesting that deforestation and degradation were high. During FGD and KI discussion with the Oloibon, it was indicated that good forest policy could militate against poor forest conditions in the CR. This need by the Oloibon was an indication that the community was appreciating that government intervention was necessary and the community would wish to have national government participation in the management of LCF. This erosion of local resource ownership and control is likely to intensify in the context of wider economic policies and legal reforms supporting the penetration of corporate activity through tourism and Government through partnership circumscribing community rights over the resource (German et al., 2014) and declaration of the area as an adjudication area.

4. Conclusion

This study has shown that forest conditions in terms of extent (size) declined in Community Regime, Government Regime and Participatory Forest Management Regime. Analysis of remotely sensed data showed that both Loita and Kakamega forests declined in size, becoming increasingly fragmented over the 1990-2010 period. However, in the Community Regime case, most respondents did not view a decrease in size. More than half of the respondents in both the Participatory Forest Management Regime and the Government Regime felt that the forest size was declining. In Community Regime, the study found that the desire of Loita Maasai pastoralists to retain their ancestral land intact and religiously conserve and preserve their environment as a whole, mainly due to their cultural solidarity and awareness, was waning. The community leadership could not cope with the pressure to over-exploit the forest resources. This scenario indicates Traditional Community Based Forest Management (CR) is no longer able to manage forests effectively. This situation also indicates the need to transform the regime to enhance its effectiveness supported by regulated access. This status would be attained by adopting some aspects of command and control management aspects applied in the government regime or schematically allowing partnerships with government and other stakeholders, as was the case in the PFM-Regime. The declaration of the area as an adjudication area would lead to individual landholding title deeds hence negating all community efforts. Adjudication may likely lead to the land subdivision into individual units leading to Loita forest degradation. The Government Regime was good for biodiversity conservation but not preferred as the managers had failed to include communities in the management and allow communities access livelihood benefits sustainably as provided for in the Wildlife Conservation and Management Act of 2013. The government officers need to realize that they are “the local state” and have to remain key actors, whenever the community requires collaboration, approval, or goodwill of the state to enjoy a stream of benefits. Therefore, the Participatory Forest Management Regime has enabled improved forest management and involved the other stakeholders in management, especially the community. Thus, the PFM regime achieved better forest management, bring-

ing on board other stakeholders, thus reducing conflicts, ensuring the community does not feel alienated from the resource, and possibly enabling communities to access benefits leading to better community livelihoods. This win-win situation makes Participatory Forest Management Regime the most appropriate. Literature has though shown that the other regimes have similar potential legally to enhance their appropriateness. This can be attained by adapting the appropriateness attributes from PFM to each regime's legal context. Officers should also be willing to utilize the existing legislative opportunities and form working partnerships with all stakeholders.

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Conflicts of Interest

The authors declare no conflicts of interest regarding the publication of this paper.

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