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## Forest Adjacent Community Perception on Fencing for Forest Conservation around Western Mt. Kenya Forest

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### ABSTRACT

Fencing for forest conservation currently applied in many countries. Data on community perceptions regarding the erection of fences aimed at conserving forests is however limited especially in developing countries. This study was carried out to assess local people attitudes on fencing for forest conservation management of Western Mt. Kenya Forest. A random sampling technique was used in administering semi structured questionnaires to 194 households living adjacent to the forest. The study established that local community members were mainly involved in clearing the fencing routes and attending meetings. Fencing reduced human wildlife conflict, game damage to forest plantations, increased forest regeneration, reduced forest destruction, reduced cattle theft and reduction in income. Majority of the respondents from the fenced location feared that fencing has resulted in reduced incomes, conflict with the authority, increased incidence of electrocution of livestock and children by the electric fence and cutting off of communities. Among the local community members, there was perceived reduction in collection of firewood from the forest, reduction in timber to the locals, reduced wild vegetables, fruits and honey from the forest but reduced livestock theft. The overall perception was that fencing has enhanced benefits towards the local communities in the region. It is recommended that fencing should be done after thorough consultation with the local community members, stakeholders and information on the benefits of fencing duly stated to the local community members living adjacent to the forests.

### INTRODUCTION

Forests are significant globally. The total forest area is 4.06 billion hectares which translates to approximately 31% the global land area (Taye *et al.*, 2021; Raihan, 2023). The forests is a source of energy, construction materials, food and medicines (Karki and Chowdhary, 2019; Sheppard *et al.*, 2020). There are also accompanying ecosystem services provided by forests such as water catchments functions, soil fertility enhancement, climate change mitigation and carbon sequestration (Higginbottom *et al.*, 2019; Hong and Saizen, 2019; Sati, 2023). Approximately 300 million people globally, mostly from developing countries of Africa depend largely on forest resources for their subsistence (Arfin-Khan and Saimun, 2020). As a result of the continued use and increasing demands of forest resources, the utilization of unprotected forest has reached alarming level of over-exploitation especially by the adjacent forest dwellers (Szulecka, 2019; Ceccherini *et al.*, 2020; Rahman *et al.*, 2022). Unsustainable and over-use of the forest resources, has resulted in forest destruction and consequential decline in forest resources including the floral and faunal biodiversity (Kimutai and Watanabe, 2016). There is a consensus that management of these forests need to control the number of people entering into the forests.

One of the most used tools since the Neolithic Age to protect forest is fencing. Fencing has emerged as an alternative conservation and management strategy to control and regulate interactions between natural

landscape resources and surrounding communities (Löf *et al.*, 2021; Patiño *et al.*, 2021). In several countries, fencing is a physical barrier, such as a standard post and wire fence to separation forest resources to meet multiple benefits and objectives ranging from ecological and protection of the habitats achieving management objectives from the like controlling the processes threatening them. Fencing and conservation of protected areas tend to be planned so as to separate natural landscapes from threatening human activities like illegal logging, crimes and thus protecting the plants (Heywood, 2019; Pekor *et al.*, 2019). From social perspective, fencing has an opportunity to reduce destruction of crops in agricultural areas which are found adjacent to most conservation areas (Mbuba, 2019). Fence boundaries have also been established to exclude and control local people from collecting fuel wood and cutting fodder and grasses from protected areas (McElwee, 2010; Musavi, 2015; Belem *et al.*, 2017). Beside fencing allows for regeneration of once cut down vegetation (Patiño *et al.*, 2021).

There is increasing interest to incorporate the use of community and stakeholders perceptions in conservation management plans. Community perceptions are of particular interest to researchers in areas where protected areas impact people living in or near those spaces. Managing conservation areas equitably is important in obtaining positive perceptions of local populations regarding fencing (Bertalan, 2019). In Kenya, the Kenya Forest Service in conjunction with non-governmental

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organizations is fencing many of the country's forest reserves. Over the years conservation of Mt. Kenya Forest has faced several threats ranging from destruction by illegal bhang growers and timber poachers, illegal grazing, invasive species and forest fires (Mbuba, 2019). Local communities have also been facing challenges associated with human wildlife conflicts (HWC), loss of lives, forest plantation game damage and destruction of croplands causing a lot of desperation to the local farmers. Mt. Kenya Forest is managed through collaborative efforts involving multiple stakeholders at different levels. At both middle and lower levels, most notable stakeholders include; Kenya Forest Service (KFS) and Kenya Wildlife Service (KWS), and Community Forest Associations (CFA). Whereas KFS and KWS are state led conservation agencies, CFAs are a conglomeration of different user and interest groups which are found within a defined geographical area of five kilometers from the forest reserve boundary. The CFAs provide a strong link between the government lead conservation agencies and the local communities. To address aforementioned challenges local communities in collaboration with other stakeholders proposed an electric fence to separate local communities and the forest reserve. The installation of the fence commenced in December 2020. However, no research has been done about the perceptions and attitudes on the local communities towards the impacts of fence on management and conservation of the forest. Thus, the attitudes of local communities who are adjacent neighbors of natural resources stock are thus critical to the success of conservation of management efforts like fencing, few studies, however, address community perceptions of government enforced fencing strategy goal. This study was therefore carried out with an objective of assessing the local people's attitudes towards fence installation.

## MATERIALS AND METHODS

### Study Area

This study was done in Western side of Mt. Kenya Forest (Figure 1). Mt. Kenya forest is an irreplaceable biodiversity hotspot with unique flora and fauna of conservation importance, which underpins its Key Biodiversity Area (KBA) status and the extant government protection. Mt. Kenya forest is home to Africa's second tallest mountain which is Mt Kenya with an elevation of 5,199 meters above sea level (asl). The forest is located in the former Eastern and Central provinces of Kenya, now Meru, Embu, Laikipia, Kirinyaga, Nyeri and Tharaka Nithi counties. Mount Kenya is the main water catchment area for two large rivers in Kenya; the Tana, the largest river in Kenya, and the Ewaso Nyiro North. The Mount Kenya ecosystem provides water directly for over 2 million people.

## METHODOLOGY

Data for this study was collected from a random sample of 96 respondents in fenced region and 98

in nonfenced regions administered to the household heads, during the month of November and December 2021. The respondents were drawn from a range of 0 to one 4 km from the fence/forest boundary. Other vital information on forest destruction and illegal activities, forest patrols, improvement on forest conservation status was collected from secondary sources and relevant key informant like forest station managers and leaders of the local community organizations like Community Forest Associations (CFA) officials. Questions were formatted as both closed and open-ended.

The researcher visited each selected household with Kenyan research assistants and at least two well-known community members before completing the survey with the respondent. After explaining the research project and the content of the survey to the household head, verbal consent was requested for participation. When consent was given, the lead researcher and assistants arranged to return to the household at a later date that was convenient for the respondent to complete the survey.

### Data Analysis

The collected data was analyzed using Statistical Packages for Social Scientists (SPSS) and presented using various graphical techniques. Data was analyzed for descriptive statistics mainly frequencies and percentages. Differences respondents in response between the fenced and nonfenced areas were analyzed using chi-square.

## RESULTS

### Socio-Economic and Demographic Characteristics of the Respondents

The respondents' socio-economic characteristics of the forest adjacent communities are provided in Table 1. The socio-economic characteristics considered were age, gender, level of education, household size and income as well as occupation. The age distribution of the forest adjacent community showed significant variations ( $\chi^2 = 159.518$ ,  $df = 3$ ,  $P < 0.001$ ) where highest proportion at both sites were aged 36-50 years, followed by those aged 18-35 years while the least number of respondents were aged over 65 years. Gender disparity occurred among the host community members ( $\chi^2 = 3.8413$ ,  $df = 1$ ,  $p = 0.0487$ ) where there were more females than male at both sites. The level of education also significantly different ( $\chi^2 = 34.094$ ,  $df = 16$ ,  $P < 0.001$ ) where majority of the forest adjacent community members had secondary level of education followed those with primary level of education. Household size for most of the forest adjacent community members ranged between 3 to 5 followed 6 to 10 members.

### Community Perception about Benefits of Fencing for Forest Conservation

Based on interviews, all the respondents had full information about the electric fence before installation at the edges of the forest boundary. Main sources of the information were from community sensitization and

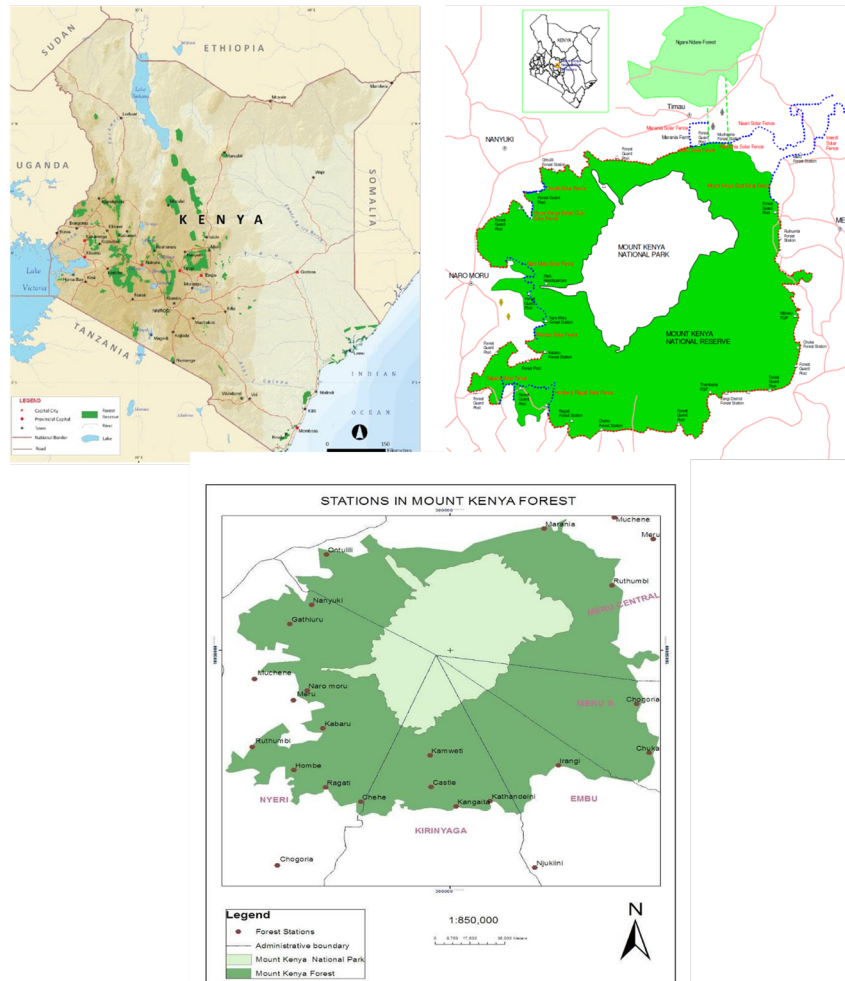


Figure 1: Location of Mt. Kenya Forest Block

Table 1: Socio-economic characteristics of the respondents

Variable	Response category	Frequency	Percent	Frequency	Percent
Age (years)	18-35	31	32.3	28	28.6
	36-50	57	59.4	52	53.1
	51-65	6	6.3	12	12.2
	Above 65	2	2.1	6	6.1
Gender	Male	44	45.8	47	48.0
	Female	52	54.2	51	52.0
Level of education	None	4	4.2	7	7.1
	Primary	20	20.8	17	17.3
	Secondary	71	74.0	67	68.4
	University	1	1.0	7	7.1
Household size	<3	10	10.4	13	13.3
	3-5	46	47.9	43	43.9
	6-10	37	38.5	33	33.7
	11-20	2	2.1	9	9.2

stakeholders meetings which were held across the villages by KFS, KWS, CFA and fence attendants. In regard to involvement, most locals were involved during fence installation. Local people were mainly involved in clearing the fencing routes and attending meetings.

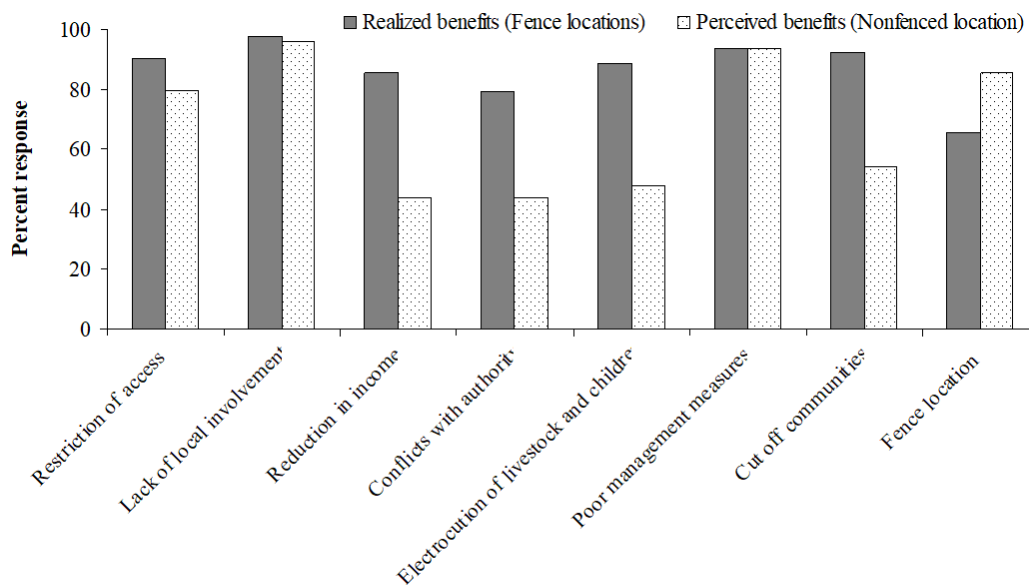
The researcher inquired from the respondents what benefits have been derived from fencing in areas already fenced and what perceived benefits the respondents will receive in areas that were not yet fenced. The results are provided in Table 2. There were differences in opinion

**Table 2:** Experienced and expected benefits of fencing for forest conservation in fenced and non-fenced locations of Mt. Kenya forest respectively

Perceived impacts	Realized benefits (Fence locations)		Perceived benefits (Nonfenced location)		Chi-square	
	Freq.	Percent	Freq.	Percent	x <sup>2</sup>	P value
Reduce human-animal conflicts	65	67.7	98	100.0	6.6810	0.0023
Improve climate	42	43.8	43	43.9	0.0118	0.6533
Reduce fires	84	87.5	92	93.9	0.3636	0.4532
Increase forest regeneration	65	67.7	93	94.9	4.9620	0.0043
Reduce forest destruction	53	55.2	88	89.8	8.6879	0.0003
Reduce income from forest products	92	95.8	66	67.3	4.2785	0.0035
Wildlife protection	89	92.7	94	95.9	0.1366	0.5643

among respondents from the fenced and unfenced location concerning reduction of human wildlife conflict, game damage to forest plantations, increased forest regeneration, reduced forest destruction, and reduction in income. More respondents in areas yet to be fenced had more positive perception that fence will reduce human-wildlife conflict, increase forest regeneration and reduce forest destruction. However fewer respondents from the yet to fenced side believed that it reduced income from forest resource. There were however a concurrence

between the respondents in fenced and unfenced sides that fencing reduced fires and resulted in better protection of wildlife. There was also a concurrence between the two groups that fencing may not result into improved climate. Result for the experienced and expected benefits of fencing for forest conservation in fenced and non-fenced locations of Mt. Kenya forest respectively are shown in Figure 2. The most commonly discussed perception in both the fenced and nonfenced location is the lack of local involvement, restriction of access, and Poor



**Experienced and expected benefits of fencing**

**Figure 2:** Experienced and expected benefits of fencing for forest conservation in fenced and non-fenced locations of Mt. Kenya forest respectively

management measures. Majority of the respondents from the fenced location feared that fencing has resulted in reduced incomes, conflict with the authority, increased incidence of electrocution of livestock and children by the electric fence and cutting off of communities.

**Perceived Impacts of Fencing Forest in Mt. Kenya**

The perceived impacts of fencing forest to the local people in fenced and non-fenced locations of Mt. Kenya forest are shown in Table 3. During interview, the key

informants were unanimous that majority of the local communities did not support fencing. From in-depth probing during the fieldwork, those who were against the practice feared that it would reduce their utilization of the forest resources and will create a problem with those in authorities especially forest rangers. Among the local community members, there was perceived reduction in collection of firewood from the forest, reduction in timber to the locals, reduced wild vegetables, fruits and honey from the forest. There are also those who claimed

**Table 3:** Perceived impacts of fencing forest to the local people in fenced and non-fenced locations of Mt. Kenya forest respectively

Perceived impacts	Realized impacts (Fence locations)		Perceived impacts (Nonfenced location)		Chi-square	
	Freq.	Percent	Freq.	Percent	x <sup>2</sup>	P value
Reduce firewood collection (dead wood materials)	87	90.6	78	79.6	0.4909	0.3480
Reduce timber	94	97.9	94	95.9	0.0000	0.0392
Reduce forest vegetables	82	85.4	43	43.9	12.1680	11.6327
Reduced forest fruits	76	79.2	43	43.9	9.1513	8.6775
Reduce honey collection	85	88.5	47	48.0	10.9394	10.4011
Reduced medicinal plants from the forest	90	93.8	94	95.9	0.0870	0.2104
Reduced livestock theft	56	58.3	12	12.2	28.4706	

it would limit their access to medicinal plants. Among the respondents from the unfenced locations, there was a perception that it would reduce collection of firewood, timber and medicinal plants with fewer believing that they will have less access to wild vegetables, fruits and honey. There was also more perceived impacts of the fence reducing livestock theft.

From in depth analysis during the household survey, most respondents cited some changes associated with installation of fence like; expansion of farming activities; improved security in the area; reduced forest illegal activities, and reduced risk to human life. However, during the fieldwork it was observed that cases of fence destruction were increasingly caused by trees and

branches that were falling off.

The overall perception perceptions that fencing has enhanced benefits towards the local communities in the region are presented in Table 4. It was evident that 55.2% of the respondents from the fenced regions strongly agreed, 24% agreed, 5.2% disagreed and only 3.1% strongly disagreed that fencing has enhanced the benefits to the local community members. Meanwhile 55.1% of the respondents from the nonfenced regions strongly agreed, 35.7% agreed, 2.0% disagreed and only 1% strongly disagreed that fencing has enhanced the benefits to the local community members. Overall the perception about fencing was positive (Mean >4.0/5.00) at both study locations.

**Table 4:** Perceptions that fencing has enhanced benefits towards the local communities

Will fence enhance protection of the forest	Fenced locations		Nonfenced location	
	Freq.	Percent	Freq.	Percent
Strongly disagree	3	3.1	1	1.0
Disagree	5	5.2	2	2.0
No opinion	12	12.5	6	6.1
Agree	23	24.0	35	35.7
Strongly agree	53	55.2	54	55.1
<b>Mean ± Std. Dev</b>	<b>4.23 ± 0.21</b>		<b>4.42 ± 0.25</b>	<b>4.23</b>
Skewness	1.52		0.93	1.52
Kurtosis	2.13		-1.33	2.13

## DISCUSSION

In Kenya fencing and conservation on protected areas has been adopted in major wildlife habitats including forest reserves, green spaces, national parks, private conservancies and Community lands. Some of the examples of fenced areas in Kenya include Karura forest, Eburu, Meru National Park, Aberdares forest reserve and National Park, Amboseli National Park; Lewa Wildlife Conservancy and Ol Pejeta Conservancy in Laikipia and Mt. Kenya Forest reserve (Pearce, 2015; Murithi, 2018; Weldemichel and Lein, 2019). To achieve conservation and management objectives there has been a tremendous effort to involve adjacent communities and stakeholders in decision making process. Accordingly,

based on interviews, it is clear that most or all of the respondents had full information about the electric fence before installation at the edges of the forest boundary. Local people were mainly involved in clearing the fencing routes and attending meetings. This concurs with several other studies that have indicated involvement of local communities in fencing activities (Mbuba, 2019) through participatory forest management (Wambugu *et al.*, 2017). Their level of involvement in the planning is what was found to be low from the key informants because that is a technical issue that is expert driven. The local obtained information from the community sensitization and stakeholders meetings which were held across the villages by KFS, KWS, CFA and fence attendants.

The study also indicated that in fenced areas, the local believed that the fencing activities was good in reduction of human wildlife conflict, game damage to forest plantations, increased forest regeneration, reduced forest destruction. These are some of the anticipated benefits of fencing around forests across the world (Honda *et al.*, 2009; Sapkota *et al.*, 2014; Dorjee *et al.*, 2021). In areas where fencing was yet to be done, the perception was that fence will reduce human-wildlife conflict, increase forest regeneration and reduce forest destruction, which is similar to the experience of the respondents from the fenced areas. In fenced locations, and nonfenced locations, HWC is often discussed in the context of the destruction of entire livelihoods through crop raiding. Communities in this study recognize destruction as a threat to the health of their forests, integrity, suggesting that indigenous or Traditional Ecological Knowledge (TEK) might play a role in the perception of forest well-being. However fewer respondents from the yet to be fenced side believed that it reduced income from forest resource this is because they will not be able to obtain firewood from the forest, timber, fruits and other resources within the forest like honey and wild game meat.

The study also established that in both the fenced and nonfenced location fencing restricted access to forest, and result to poor management measures. Majority of the respondents from the fenced location feared that fencing has resulted in reduced incomes, conflict with the authority, increased incidence of electrocution of livestock and children by the electric fence and cutting off of communities. While not an explicit cost, the unexpected placement of the fence itself was also frequently discussed as the reason for many of the experienced costs. The use of fencing may have ecological benefits, however, fencing also has the potential to threaten the equity of protected area management. Community perceptions of fencing provide valuable insight into what forest dependent households expect and experience when a fence is constructed around their forests. The following observations concerning expected and experienced perceptions in the communities in this study may be useful when designing, implementing, and adapting conservation plans in other contexts. Just as benefits are site specific, so are expected and experienced costs. While restricted access is a major concern across all four sites, some concerns are specific to individual locations.

The expected benefits discussed in non-fenced locations revolve around six themes. In recently fenced locations, the numbers of benefits experienced reflect eight themes. In fenced locations, fenced in 1999, the experienced benefits are limited to four themes. This could be, in part, because so much time has passed. Some of the respondents in fenced locations were in their late teens when the fence was placed and much of their adult experience is post-fence. It could also be a reflection of unfulfilled expected benefits. Livestock theft, a benefit that is a common theme in fenced locations, is never mentioned in other locations. Fenced locations respondents report that in the

past, outsiders came to the community, stole livestock, and used the forest as a hiding place and escape route. To residents there, the newly built fence is the main reason for the decrease in livestock theft. Respondents in Fenced locations and nonfenced locations are the only ones to discuss climate improvement as a benefit derived from fencing the forest.

Respondents in all communities extensively discuss lack of or restricted access to the forest and its resources as a significant cost to fencing. In fenced locations, few respondents were using the forest for any resources. In nonfenced locations, more respondents were using the forest for some of their household needs. While some users attribute the change in use to an increase in resource availability at their homes, most change in resource use is attributed to difficulty reaching the forest gate or negotiating permits with CFA leaders and forest rangers. The study also established that the overall perception about fencing was positive at both study locations. It was evident that most of the respondents from the two locations strongly agreed and agreed that fencing has enhanced the benefits to the local community members. This is line with other studies elsewhere (Pekor *et al.*, 2019; Feuerbacher *et al.*, 2021). While this is not a longitudinal study, and survey questions were not asked before and after fences were built, there is an obvious difference in perceived benefits and conservation capability of forest resources in fenced and non-fenced locations. Whether these differences in perceptions are directly related to fencing is not clear. However, it does pose a challenge to managers to think about the potential for fencing to encourage a disconnect between humans and nature and how that might shape institutions meant to encourage decentralization, like CFAs.

## CONCLUSION

The study determined the forest adjacent community perception on fencing for forest conservation around western Mt. Kenya Forest. The study established that the respondents had full information about the electric fence before installation at the edges of the forest boundary and the local people were mainly involved in clearing the fencing routes and attending meetings. Study also determined difference in opinion among respondents from the fenced and unfenced location concerning reduction of human wildlife conflict, game damage to forest plantations, increased forest regeneration, reduced forest destruction, and reduction in income. More respondents in areas yet to be fenced had more positive perception that fence will reduce human-wildlife conflict, increase forest regeneration and reduce forest destruction. There were however a concurrence between the respondents in fenced and unfenced sides that fencing reduced fires and resulted in better protection of wildlife. In terms of experienced and expected benefits of fencing for forest conservation in fenced and non-fenced locations of Mt. Kenya, the most commonly discussed perception is the lack of local involvement, restriction

of access, and poor management measures. Majority of the respondents from the fenced location feared that fencing has resulted in reduced incomes, conflict with the authority, increased incidence of electrocution of livestock and children by the electric fence and cutting off of communities. There was fear among local community members that fencing would reduce utilization of the forest resources and will create a problem with those in authorities especially forest rangers. Among the local community members, there was perceived reduction in collection of firewood from the forest, reduction in timber to the locals, reduced wild vegetables, fruits and honey from the forest but reduced livestock theft. Among the respondents from the unfenced locations, there was a perception that it would reduce collection of firewood, timber and medicinal plants with fewer believing that they will have less access to wild vegetables, fruits and honey. The overall perception was that fencing has enhanced benefits towards the local communities in the region.

This study does not make any claims that the use of an electric fence is the sole cause of any specific perception. Rather, it recognizes that each forest and each community has characteristics that are unique to that location and those characteristics influence people's perceptions in different ways. The results should discourage the implementation of new conservation tools without assessing the community needs, expectations, and local norms prior to, and throughout, the implementation of the conservation management plan. Community perceptions are especially important to consider when using one conservation tool across many different sites, and when balancing centralized conservation techniques with decentralized conservation goals. This study has provided evidence that fencing as a management tool has contributed significantly towards enhanced forest protection, management and conservation.

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