Forest and Communities

Deforestation, Conservation, and Socio-ecological Relations in the Mau Forest, Kenya

Stefania Albertazzi
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1. Introduction

This book explores the relationship between forests and local communities in the case of the Mau Forest protected area in Kenya by explaining the deforestation process, the conservation initiatives, and the different forms of interaction between people and forest ecosystems. The Mau complex (380,000 hectares [ha]) is one of the most important forests in Kenya and East Africa. It is rich in plant and animal biodiversity, is home to species of high conservative value, and is claimed as ancestral land by the Ogiek indigenous people.

In the decade of the 2000s, the deforestation process occurring in the Mau Forest due to a government redistribution of forest land for political reasons received international attention and led to interest on the part of the United Nations Environment Programme (UNEP) itself (headquartered in Nairobi) and some conservationist non-governmental organizations (NGOs) (e.g., East African Wildlife Society, Kenya Forest Working Group, World Wide Fund for Nature, and the International Union for Conservation of Nature [IUCN]). This process caused a successive phase of nature conservation that has become more structured since 2012, when the Government of Kenya granted Water Tower status to the Mau Forest, thus emphasizing the forest's fundamental role in the country's hydrographic network. Loss of forest land and the subsequent conservation interventions have resulted in what is now called the "Mau Forest".

This book analyzes three forest sections belonging to the broader Mau complex—Ndoinet (and the Southwest Mau Forest sector in which this section is located); Kiptunga (in the East Mau sector), and Koibatek (in the Mount Londiani sector in the northern part of the forest). The book consists of two parts. The first focuses on the characteristics of the forests, their biodiversity, and the deforestation process. The second addresses more specifically the relationship between nature and society.

Part 1 comprises four chapters. In Chapter 2, we introduce the study area in geographical and historical terms. In Chapter 3, we describe the deforestation process that affected the Southwest Mau sector, the core of the Mau Forest Complex, using an analysis of satellite images. Finally, in Chapter 4 the cross-checked results of a participatory wildlife assessment and fieldwork in the forests are presented, highlighting the different degrees of biodiversity characterizing the different parts of the three forests.

Part 2 describes the relationship between the forest and the local communities through four social and ecological arrangements we have called socio-ecologies (Moore, 2003). Chapter 5 delves into the topic of forestry, investigating the specific nature produced by the plantations of exotic trees (pine, eucalyptus, and cypress) within the Mau Forest. Chapter 6 elaborates on the role of the

grasslands within the protected area in the life of local communities located around the forest. The conservation of the forest in its various forms is described in Chapter 7, underlying the economic and political interests at stake. Finally, in Chapter 8 we discuss the renewed relationship between some indigenous Ogiek groups and the forest, based on the inclusion of traditional elements in new national and international networks. In conclusion, we highlight the salient points of the research and propose seven strategies for conserving the forest and enhancing a sustainable relationship between nature and society.

1.1 Theory and methods

The main objective of this book is to present the results of field research in three specific sections of the Mau Forest conducted by combining geographical and biological expertise; therefore, our work does not primarily have a theoretical purpose. However, the research does fit into a specific theoretical framework defined by the social construction of nature theory (Castree, 2001), which can be summarized in the idea that "nature is defined, delimited, and even physically reconstituted by different societies" (Castree, 2001, p. 3). More specifically, the book draws on two perspectives, the political ecology approach (Bryant, 2001) and that of the literature on the "production of nature" (Smith, 1984). In different ways and from complementary points of view, these two perspectives allow us to reconstruct the process by which nature, in this case that of the Mau Forest, co-evolves (Harvey, 2010) with the different social groups that interact with it. From this perspective, the "nature" with which society is confronted is always a product of previous actions. This is not the place to engage in an in-depth debate on the concept of "first" and "second" nature (Smith, 1984; Loftus, 2012); however, it is important to point out that what is now characterized as "nature"– in our case the Mau Forest – is anything but a primal datum and is instead the product of prior social-environmental configurations.

First, certainly, the delimitation of a protected area called the "Mau Forest" and its contemporary narrative as a "nature reserve" are cultural products of a certain society that has experienced a specific history. In particular, some authors (Peluso and Vandergeest, 2001) have traced the genealogy of the category of "forest", particularly in tropical areas, relating it to colonial history. In the perspective we present, however, the "production of nature" is not limited to the discursive level and invests the materiality of the forest; the different "forests" found within the Mau reserve with their plant and animal species are the product of past and present social choices.

The research that structures the book was carried out in the last 5 years (2017–2022), although the biodiversity assessment in Kiptunga started in 2013. The investigation is based on a mix of qualitative and quantitative methodology. The documentary analysis (gray literature) first addressed the technical

reports on deforestation and conservation processes (e.g., the Mau Task Force, UNEP, the Ministry of the Environment, and the Kenya Forest Service [KFS]). Furthermore, we consulted several archives at the National Archive of Kenya in Nairobi, the Archive of the Rift Valley Province in Nakuru, and the Daily Nation Archive in Nairobi. We also consulted the library of the KFS at the Nairobi Headquarters, together with the colonial and/or post-colonial maps and documents that in certain cases were available at forest stations. The National Archive in Nairobi contains records of the colonial and post-colonial period in the form of letters exchanged between administrators (at the provincial and district levels and with the capital city), reports, and maps related to the forest status of Mau. The Rift Valley Province Archive (RVPA) in Nakuru contains documents from the post-colonial period that take the form of minutes or reports related to eviction operations, Settlement Committee meetings, letters between administrators, and letters from village communities. Furthermore, it is possible to consult documents pertaining to the forestry, land, and administrative spheres in general. At the Archive of the Daily Nation, one of Kenya's leading newspapers, dozens of press articles relating to the Mau Forest, to disputes about the resettlement program, to the illegal appropriations by the country's political class, and to the Ogiek issue were collected for the period ranging from the 1970s to the second half of the 2000s (after that date, articles from the Kenyan press can be found online). The KFS library at the Nairobi Headquarters was also consulted, and numerous valuable reports relating to the work of a British conservation project called the Kenya Indigenous Forest Conservation Programme (KIFCON) in the 1990s were found. At the same time, secondary data were collected from several offices dealing with forest management, nature conservation, land use policies, and water management.

In the first phase of the research, we carried out a remote sensing analysis to investigate land cover changes using Landsat satellite images (1995, 2000, 2003, 2008, and 2014) and Sentinel-2 satellite images (2019; see chapter 3 for methodological details). During the fieldwork, we conducted semi-structured interviews with 105 members of local communities around the Ndoinet Forest section and with about 15 members of local communities close to Kiptunga Forest. Furthermore, 30 semi-structured interviews were conducted with Administration (Ward Administrators, Chiefs, various officers), the KFS and Kenya Water Tower Agency (Forest Managers, Chief Ecosystem Conservator, local rangers, Regional Coordinator), NGOs defending nature conservation or indigenous rights (Rhino Ark, National Alliance of Community Forest Associations, Kenya Forests Working Group, Ogiek People Development Program), various researchers (from the Kenya Forestry Research Institute, the Center for International Forestry Research, or the Integrated Forestry Consultancy and Management Services), companies (Finlays Kenya Ltd.), and community forest associations (CFAs) (Koibatek CFA, Ndoinet CFA, and

Kiptunga CFA). More than 20 forest walks with community members and KFS rangers were undertaken in the three forests[1].

In addition, an in-depth 2-month work study on the participatory mapping of biodiversity and ecosystem services in Koibatek Forest, Ndoinet Forest, and Kiptunga Forest was conducted in 2017 together with members of local communities (for more details on the methodology, see chapter 4). The process of the participatory mapping of wildlife and ecosystem services was always tested by transect walks in the forest aimed at detecting direct and indirect signs of wildlife and, in the case of Kiptunga, by deploying camera traps on the ground[2].

This work would not have been possible without the cooperation of many people who accompanied us in the research. In particular, the Authors would like to thank the members of the CFAs of Kiptunga, Koibatek and Ndoinet, Samuele Tini, Duke Morema, the nonprofit organization Drones for Earth (former Drone Adventures), Marco Cortesi, Enrica Soria, Anthony De Bortoli, the staff of the NGO Necofa and the staff of the Kenya Forest Service.

1 For qualitative data processing, we used SPSS Statistics 22 and ATLAS.ti 7 software, and for spatial analysis we used Google Earth, ERDAS IMAGE 2015, and QGIS software.

2 A transect walk is a method used in biological research for the survey of wildlife, particularly to estimate population density. It is based on the definition of a sample area and of perpendicular lines at a certain distance (e.g., 1 km) that are walked by researchers who count the number of animals directly sighted or indirectly detected based on their signs (nests, dung) in the case of poor visibility due to vegetation (Plumptre, 2000). This method differs from more qualitative participatory-oriented walks where researchers move in an area (e.g., a rural village, a forest) together with local community members with the aim of collecting data or sketching a map in an exercise interspersed with observations, conversations, and discussions about the social or ecological characteristics of the place (Chambers, 1994).

Part I
The socio-environmental context

The first part of this book aims at introducing the social and environmental framework of the Mau Forest, with specific reference to the three forest sections that constitute the research area—Koibatek, Kiptunga, and Ndoinet. The selection of these three sections relates to the origin of the research project that was initially part of an international cooperation initiative developed by the NGOs Network for Ecofarming in Africa (Necofa) and Mani Tese, with the support of private and public donors (particularly Cariplo Foundation and the Italian Agency for Development Cooperation [AICS])[1].

The forests were identified by the NGOs as strategic hotspots to fight against deforestation and to develop forms of community conservation that were the core of their development approach. The three areas in fact show significant differences in both their social and environmental structures (presented in chapter 2) but share two decisive elements—they lie at the core of the forest, where important rivers find their sources, and they were subject to significant controversies and conflicts, particularly at the end of the 1990s when large portions of the forest were converted to agricultural use.

The reconstruction of these conflicts is the main object of Chapter 3, which focuses on the Ndoinet section, probably the area that suffered the most complex evolution in the Mau Forest, alternating between informal occupation, formal settlements, evictions, and new forms of coexistence between the forest and the local communities. Understanding the succession of these past events is extremely important to read the present situation because it has defined what kind of nature characterizes the forest today and the specific form of interaction that the local communities have with the forest, the subject that is at the core of the present research. Satellite images combined with data from local and national archives (see chapter 1 for sources and methods) revealed an east–west movement of the forest boundary that first shifted westward far beyond the present limit and then receded to its present position during the first decade of the century.

Chapter 4 presents the results of three participatory biodiversity assessments developed in the research area to understand the size and characteristics of the wildlife population, its distribution within the forest sections, and thus the

1 The research was partly conducted within the framework of two international cooperation projects: "Local economies, biodiversity protection and responsible tourism development" (funded by Cariplo Foundation and Regione Lombardia, 2014–2015) and "IMARISHA! Rural energy for the fight against climate change and for the protection of the environment (Kenya)" (funded by the Italian Agency for Development Cooperation, 2017–2019).

existence of strategic hotspots for biodiversity conservation. The issue of wildlife is central both because biodiversity is a specific forest value and because the future of forests, particularly in Africa, is closely linked to the possibility of establishing a sustainable relationship between human and non-human animals. The reason for choosing a participatory research methodology lies not only in the effectiveness of the method but also in the desire to identify conservation pathways that are not imposed from above on local people and that, on the contrary, see the community at the center of the process.

The three context chapters show the irresolvable entanglement between the natural and social components that is at the root of the present study. To deal with such complexity, it was necessary not only to mobilize different disciplinary expertise but also to establish a continuous dialogue between the authors, two geographers, and a biologist to cross the barriers that still exist between the natural and human sciences in terms of approaches, methodologies, and language. In this way—"at the appointment of giving and receiving" in the words of Léopold Sédar Senghor—we wanted to force the limits of individual disciplines, illuminating their blind spots and trying to produce original interpretations.

2 Research area

2.1 The Mau Forest: geographical and historical background

The Mau Forest lies in the Kenyan Rift Valley and is the largest tropical montane forest in East Africa. The forest complex consists of 16 main sectors and six non-contiguous satellite areas, covering approximately 380,000 ha. All the sectors, with the exception of Maasai Mau in the southern part of the forest complex, are classified as state forest reserves. The area has been gazetted since 1932 and is now managed by the KFS.

The forest complex extends along a 150 km north–south axis in the counties of Elgeyo Marakwet, Uasin Gishu, Baringo, Nandi, Kericho, Nakuru, Bomet, and Narok at an altitude between 1200 m and 3000 m. The landscape is typical of the Rift Valley, with steep slopes alternating with plateaus and reliefs with softer shapes. The fertile soils of volcanic origin and the humid climate (1,000 mm–2,000 mm of rain per year) make this area particularly suitable for agriculture and livestock, favoring human settlement. The Mau complex is in fact located in one of the most densely populated areas of Kenya, a country where 82% of the territory is classified as arid and semi-arid (less than 700 mm of rain per year; UNEP, 2009).

The forest harbors the sources of 12 important rivers of western Kenya that feed lakes on which tens of millions of people depend—Lake Victoria, Lake Nakuru, Lake Turkana, Lake Baringo, and Lake Natron. These rivers contribute greatly to agricultural activities, energy production, and the tourism sector.

In terms of commercial agriculture, the lands around the forest are home to extensive tea plantations that date back to the colonial period and are now owned by a number of multinational companies, namely Unilever[1] and Finlays, large Kenyan families (including the family of former President Daniel Arap Moi), and a number of producers affiliated with Kenya Tea Development Agency Holdings Limited (KTDA Ltd.), the historic state-owned company privatized in 2000.

The forest's ecosystem services also provide vital support to small-scale farming. The region is the ancestral land of the Ogiek people (approximately 52,000 people in the last census; KNBS, 2019), originally a hunter–gatherer

1 In July 2022, Unilever announced it had completed the selling of its Kenyan tea plantation to the CVC Capital Partners Fund VIII for € 4.5 billion (https://www.unilever.com/news/press-and-media/press-releases/2022/unilever-announces-completion-of-the-sale-of-its-tea-business-ekaterra/).

ethnic group that is now settled around the forest. Alongside this original population, other agro-pastoral tribes belonging to the broader Kalenjin ethnic group have settled in the area over the past few decades, with government support, thus increasing the pressure on the forest (see sub-chapter 2.3).

Moreover, it should be highlighted that the rivers that originate in the forest make an important contribution to the hydroelectric sector, which produces 30% of the national energy. Finally, tourism, which generates more than 10% of the national GDP, also benefits from the ecosystem services produced by the Mau Forest. In particular, two famous tourist destinations, the Maasai Mara National Reserve and the Lake Nakuru National Park, depend on rivers the sources of which are located in the forest (GoK and UNEP, 2008).

For all these reasons, the forest plays a crucial role in the development of the country, and the government has included the Mau Forest among the five most important country's "water towers"—the Mau Forest Complex, the Aberdare Mountains, Mount Kenya, Mount Elgon, and the Cherangani Hills—that have to be protected with special actions. However, beyond this strategic role of "water tower", the Mau Forest ecosystem has extraordinary value in terms of vegetational and animal biodiversity.

The vegetation inside the forest changes with altitude. It is in fact progressively denser as the altitude increases up to 2,500 m above sea level (asl), when bamboo begins to prevail. In the higher areas, it is characterized by grasslands. In the areas of dense forest that are mainly located between 2,000 m asl and 2,500 m asl, there are some important species of indigenous vegetation, such as *Albizia gummifera*, *Prunus africana*, *Olea capensis*, *Ficus thonningii*, and *Podocarpus latifolius*. Besides the native vegetation, there is also an important presence of allochthonous species that was introduced in colonial times to foster forestry activities. The vegetational patterns produce very different ecosystems: on the tree plantations, there is a drastic decline in biodiversity compared to areas of indigenous forest, where there are still many animal species of high naturalistic value. In particular, these areas are home to some species considered at risk of extinction, such as the African golden cat (*Caracal aurata*, IUCN, Vulnerable) and the yellow-backed duiker (*Cephalophus silvicultor*, IUCN, Near Threatened).

The story of the Mau Forest is strictly connected with the historical and political dynamics. During the colonial period, the Mau complex was surrounded by British settlements in the plateau of the Rift Valley in what were renamed the "White Highlands". The preference of the British colonizers for this area was due to the favorable climate and the presence of fertile lands, a dense water network, and a forest rich in tree species (Morgan, 1963). The status of "forest reserve" was granted to the different forest sectors between the 1930s and the 1950s to protect the timber that the colonial government intended to be a strategic asset for both the Kenya–Uganda railway and for the development of the logging sector. These objectives are also behind the creation of the first

tree plantations with exotic species in the first decades of the 20th century (Ofcansky, 1984).

At the same time, the gazettement of Mau as a natural protected area resulted in the eviction of the Ogiek indigenous groups who lived in the forest. Those operations ensured the dispossession of Mau Forest and the sedentarization of these semi-nomadic groups, thus ensuring cheap labor for the colonizers' farms (Cavanagh, 2017). With independence, the forest was declared the Central Forest Reserve (1964). However, the organization changed little, and colonial companies such as Timsales—now administered by Kenyan management—continued to control large portions of the forest for silviculture in association with the Forest Department.

The situation changed dramatically in the 1990s when a conservation project called KIFCON (1991–1994), funded by the UK government, envisaged the conversion of part of the protected area to settlement zones to definitely sedentarize the Ogiek people living irregularly in the forest (KIFCON, n.d.). Following the KIFCON recommendations but subverting the original purpose, the government of President Moi (1978–2002, Kenya African National Union Party [KANU]) set up an ambitious settlement scheme initiative (1994–2001) that produced decisive socio-territorial transformations in the region. First, the protected area lost more than 60,000 ha, with the highest percentages in the Eastern (-54%) and Southwestern (-27%) sectors, at that time converted to settlement and agricultural use for the population (RVPA, FOR. 13/5/1 Vol. 1). Second, the initiative, originally aimed at the Ogiek community, attracted thousands of people coming from the other Rift Valley Province districts, such as Bomet, Kericho, and Baringo. As will be explained in sub-chapters 2.3 and 3.1, forest land was used by the Kenyan government to build its political support in a delicate phase of the country's transition to democracy (Boone, 2012; Morjaria, 2012).

In 2001, the government issued a notice for the degazettement of the 60,000 ha of forest, thus sanctioning the land cover change that occurred in the previous decade. This process was heavily contested inside the country (Mau Forest Task Force, 2009), and worldwide environmental NGOs protested openly against what was seen as a strong deforestation act.

Even after the degazettement, Mau settlement schemes continued to attract migration flows that led to the irregular occupation of large parts of the forest. Subsequently, particularly in the period 2000–2008, several evictions took place (Daily Nation, 2002; Daily Nation, 2002b; interviews from 2019 and 2020), followed by further encroachments. In 2008, the alarm raised by the UNEP and the government of Kenya (GoK and UNEP, 2008) marked the start of a forest conservation phase that became particularly effective in 2012 with the granting of the "water tower" title to Mau, thus emphasizing the fundamental

role played by the Mau Forest Complex in the water network of Kenya[2]. The legal creation of this new category was accompanied by the establishment of a dedicated organization (the KWTA) designed to manage forest assets of national importance. Since then, the Mau Forest Complex has not experienced significant alteration of its cover.

Even if the encroachments on the Mau boundary in the research area are no longer a main issue, the establishment of highly populated settlements around the border of the Mau Forest puts strong pressure on the protected area, particularly regarding firewood collection and grazing. The ethnic composition of the population in the settlements saw some changes as well, such as the relative decrease of the Ogiek component and the parallel growth of other groups linked to President Moi (Kipsigis, Tugen)[3]. This social transformation contributed to the establishment of a conflictual environment that still characterizes the area.

2.2 The three forest sections: Koibatek, Kiptunga, and Ndoinet

The research area covers three sections of the central part of the forest: Koibatek (part of the Mount Londiani sector), Kiptunga (East Mau), and Ndoinet (Southwest Mau). The areas around these forests host approximately 850,000 people, 720,000 in the areas of Kiptunga (Molo and Njoro sub-counties) and Ndoinet (Kuresoi North and Kuresoi South sub-counties) and 130,000 in the Koibatek sub-county (KNBS, 2019).

2 The "water tower" status is a legal entitlement established in 2012 by the corresponding Kenya Water Tower Agency (KWTA), a state corporation that falls under the Ministry of Environment. The granting of the title marks the recognition of a forest's national importance in terms of water supply and conservation and the need for a more comprehensive approach in its management. In fact, the Agency is characterized by the adoption of a multiple ecosystem services perspective (rather than a mere exclusive focus on forest cover or water supply) and by being a coordinating body of national offices, local communities, and development partners (see https://watertowers.go.ke/history/). In practical terms, the Agency's operations are unclear. In the case of Mau, the KWTA is very active in the Maasai Mau sector, where it coordinates nature conservation initiatives, perhaps because it is not an officially gazetted forest. In the other Mau sectors, it is actually the Kenya Forest Service that is the most active stakeholder.

3 The Kipsigis and Tugen, together with the other sub-tribes (Keiyo, Marakwet, Nandi, Pokot, and Sabaot) comprise the macro ethnic group of Kalenjin people. They come from the Rift Valley region, but their presence in the area adjacent to the Mau forest is due to migration flows that occurred in the 1980s and 1990s, particularly in relation to the creation of government settlement schemes.

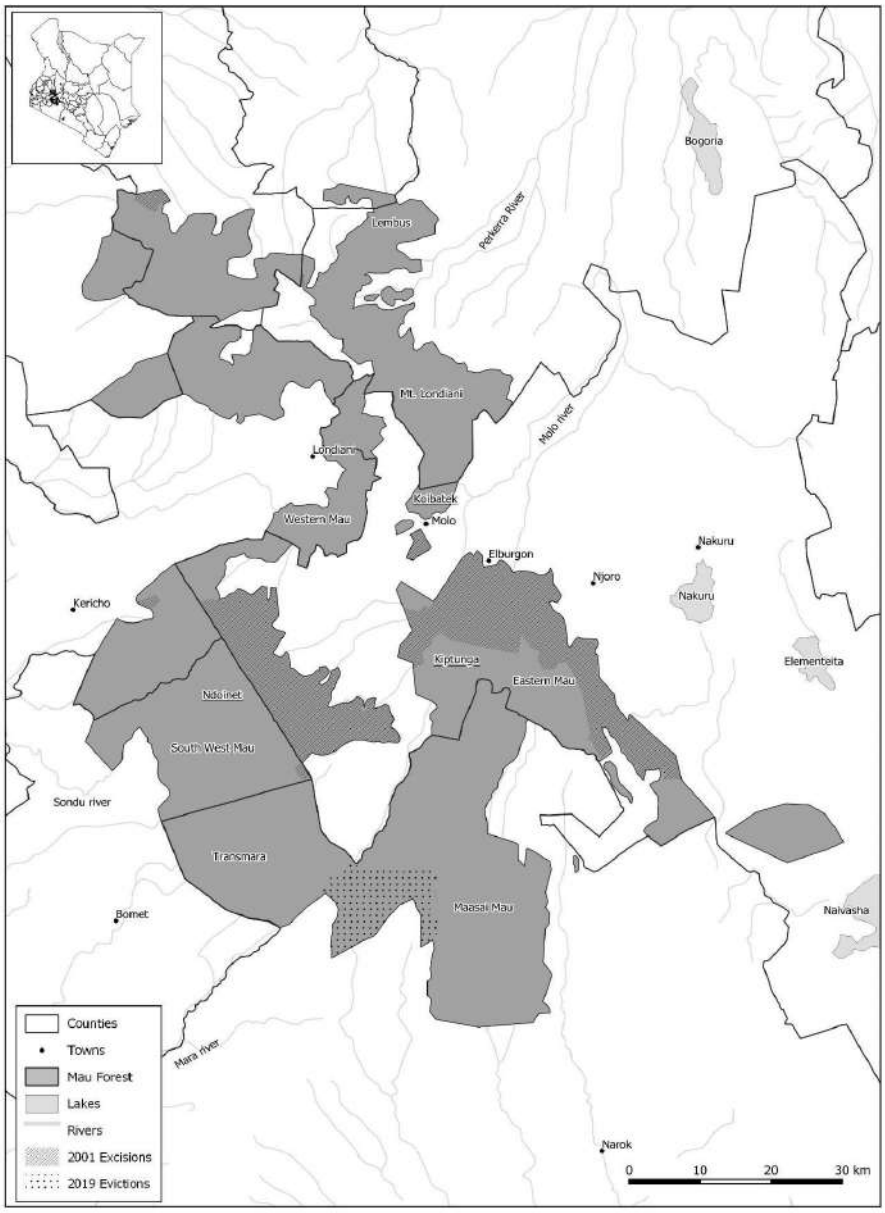

Fig. 2.1 - The Mau Forest (edited by the authors, GoK and UNEP, 2008)

Koibatek Forest

Koibatek Forest covers an area of about 9,000 ha and is located mainly in Baringo County. The physical characteristics of the forest reflect those of the entire Mau complex, with rainfall ranging from 800 mm in the lower areas to 1,200 mm in the higher areas and temperatures between 15 °*C* and 35 °*C,* making it relatively cool from June to October and warmer from December to March. In this forest is particularly evident the volcanic structure that characterizes the whole area of the Mau complex; in fact, Koibatek occupies the southern slopes of an extinct volcano (KFS, 2013).

From a hydrographical point of view, the forest contributes to the water basin of the Molo River, the main tributary of Lake Baringo, the second largest lake in the Kenyan Rift Valley and a center of great importance for biodiversity, particularly for birdlife (Ramsar site since 2002).

Koibatek has been a protected area since 1932 and, unlike the other two sections, has not lost much area over the decades (about 100 ha). However, the forest is surrounded by a highly populated area that has conditioned its evolution. Of the three forests, Koibatek is the one where the silvicultural component is greater, with 2,967 ha of plantations (about 30% of the total, mostly in the lowest part), while indigenous forest occupies about 3,300 ha (37%) and bamboo another 2,500 ha (30%). The presence of tree plantations is directly linked to the Plantation Establishment Livelihood Improvement Scheme (PELIS), a government program that allows the local community to temporarily cultivate land in protected areas designated for forestry (see sub-chapter 5.2), while assuring the maintenance of the plantation. The main species used in forestry are cypress (*Cupressus lusitanica,* 1,580 ha) and pine (*Pinus patula, Pinus radiata,* 700 ha), with minor areas devoted to eucalyptus (*Eucalyptus sp.*, 170 ha). The highest part of the forest is characterized by important indigenous vegetation to which corresponds a richer fauna, with several species classified as "threatened" by IUCN (e.g., buffalo, antelopes). There are also significant cultural sites (caves) in this portion of the forest.

Kiptunga Forest

Kiptunga Forest now occupies an area of 10,300 ha within the eastern sector (which has a total area of approximately 31,000 ha) within Nakuru County. The entire East Mau has suffered significant losses of forest area, particularly in the 1990s, when 35,000 ha (54% of the eastern forest sector at that time) were converted to settlement schemes marked by small-scale agriculture. The forest area covers the ridge (2,900 m asl) that separates the Rift Valley watershed and the drainage basin of Lake Victoria. The hydrographic network of the forest is crucial because here are the sources of some of the most important watercourses of the region—the Molo River, directed to Lake Baringo lake; the Njoro River, which feeds Lake Nakuru; and the Mara River that, after crossing the lands of the Maasai Mara and Serengeti parks, flows into Lake Victoria (KFS, 2015).

The forest was put under protection in 1958 with the double intent of protecting the vegetation and ensuring the regular course of forestry. The coexistence of these two purposes can still be seen today; the forest hosts 7,300 ha of indigenous forest (70%) and 2,000 ha of tree plantations (19%)[4]. The socio-environmental value of the indigenous forest is partly limited by its great fragmentation; of the four sections that form the forest (Chebuin, Olengape, Kiptunga, and Kiboyet), only one (Chebuin) is relatively uniform and hosts the greatest animal biodiversity.

Kiptunga is the only section of the forest in which there are still Ogiek villages within, but on the edge of, the protected area, allowing this population to maintain the socio-environmental relationship with the forest that characterizes its culture, including honey production, collecting medicinal herbs, and performing rituals. This is also why in this section of the forest the claims of the Ogiek are particularly strong and the latent conflicts most critical (Mkawale and Gachui, 2020).

Ndoinet Forest

The Southwest sector of Mau constitutes the largest sector of the forest complex (approximately 60,000 ha) and is composed of four forest sections the boundaries of which are administrative rather than ecological—Ndoinet (about 20,000 ha), Itare, Maramara, and Kericho. The landscape of Ndoinet is characterized by undulating reliefs and valleys that decline towards the west, following various watercourses that are part of the Sondu–Miriu and Mara river basins (Lake Victoria watershed). The elevation of the southwest sector varies between 1,900 m and 2,500 m, and the area receives approximately 2,000 mm of annual rainfall, with average annual temperatures in the range of 12 °C–21 °C (Konoin Kabara Community Forest Association-Itare, 2013; KFS, 2018). Like other parts of the forest complex, the environmental context is characterized by its volcanic origin, with nutrient-rich clay soils particularly suitable for agriculture (Courtney Mustaphi et al., 2014). The vegetation follows an altitudinal zoning from west to east, with montane forest (at elevations below 2,300 m) gradually giving way to highland bamboo (*Arundinaria alpina*) mixed with grasslands and finally to sclerophyllous montane vegetation near the escarpment ridge. Tree species characteristic of the lower montane forest include *Aningeria adolfi-friedericii* and *Strombosia scheffleri*.

This area has suffered heavily from human intervention. With the 2001 degazettement, the Ndoinet Forest (at that time known as Tinet Forest[5]) lost

4 The other vegetation types are bamboo (4.3%), grasslands (3.4%), and bushlands (2.6%).

5 The part of the forest belonging to Southwest Mau and now occupied by government settlement schemes was known in earlier decades as Tinet Forest (RVPA, FOR 13/5/1 Vol. 3). Interestingly, the name is of Ogiek origin and refers to a tree important to the indigenous group. Today, Tinet is the name of the southern part of the area, part of Kuresoi South sub-county.

almost 25,000 ha, an area larger than that of the current forest section. As will be seen later, the Ndoinet Forest has been occupied by irregular settlements that have been progressively removed during the 2000s. The cleared areas are now dominated by pioneer species, such as *Tabernaemontana stapfiana*, *Syzygium guineense*, and *Neoboutonia macrocalyx*, while the less impacted areas of forest are home to indigenous species, such as *Olea capensis*, *Prunus africana*, *Albizia gummifera*, and *Podocarpus latifolius* (BirdLife International, 2018; KFS, 2018). The native forest section provides a habitat for a rich fauna, including mountain bongo (*Tragelaphus euryceros*), buffalos (*Syncerus caffer*), elephants *(Loxodonta africana*), yellow-backed duikers (*Cephalophus silvicultor*), dik-diks (*Madoqua Kirkii*), the colobus guereza (*Colobus abyssinicus*), and honey badgers (*Mellivora capensis*).

The Southwest Mau is bordered on its northwestern edge by tea plantations, which cover more than 20,000 ha in Bomet and Kericho counties. These areas are mostly owned by two transnational companies (Unilever and Finlays), thus reflecting the enduring relevance of the colonial legacy. East of the forest sector are located settlement schemes that are divided from the forest by a 32 km-long boundary, and by a 10 km-long tea buffer zone planted in the last few years to physically demarcate a separation between the protected area and the villages. The settlement schemes are defined by an orthogonal geometry of small farms (0.5 ha–2 ha) centered on the cultivation of a small number of products (maize, potatoes, beans, peas, cabbage, and occasionally tea) and livestock rearing (cattle, sheep, goats, and poultry). On the farms are also common fruit trees and planted exotic trees (pines, cypresses, eucalyptus) used to meet the energy needs of the inhabitants, which are based almost exclusively on wood, coal, and kerosene. In the southern section of the Ndoinet Forest between Kipkongor and Kiptagich is a 2000-ha area occupied by settlements, despite being located within the boundaries of the protected area; this is a remnant of previous irregular settlements (see Fig. 2.2).

Finally, close to the Ndoinet Forest section in an area called Chematich, in 2016, the Italian company Cooperativa Muratori Cementisti (CMC) started the construction of the Itare dam with the purpose of diverting water from the Lake Victoria basin to the Rift Valley watershed through a 114-km tunnel to supply the city of Nakuru with safe water (800,000 beneficiaries)[6]. Work on the dam is currently suspended due to the economic difficulties of the Italian company and to a legal action concerning the construction of two dams by CMC in Kenya.

6 The dam is a medium-sized (280 ha) artificial reservoir the design of which was presented by the Rift Valley Water Services Board and is one of the cornerstones of Kenya Vision 2030, the national long-term development plan (Rift Valley Water Service Board, 2015).

2.3 A brief history of Mau Forest settlement schemes

Settlement schemes in Kenya started in the last years of colonial dominion (1955–1963) and were then frequently adopted by the subsequent Kenyan government to address poverty and boost economic development by allocating land to specific groups of people (Shaffer, 1967; Wayumba, 2019). In the case of the Southwest Mau and East Mau sectors, officially the government purpose was to allocate land to the Ogiek who lived informally within the Mau Forest. It was a measure suggested by KIFCON (1991–1994) to respond to the degradation of the Mau Forest and to find a permanent solution (Bateson, n.d.; KIFCON, n.d.). In fact, since the first decades of the 20th century the Mau Forest has been inhabited by communities that the colonial officials identified as Wadorobo Ogiek[7] that were known to be hunters, gatherers, and semi-nomadic beekeepers (Kratz, 1980; Sang, 2001).

Archival documents reporting government officers' correspondence illustrate that since the 1970s the Ogiek were not the only group living in the forest. Mau Forest was a place of life for thousands of other people who lived scattered about the area and who found in that environment the possibility of surviving on small-scale agriculture and animal husbandry (RVPA, FOR 13/5 Vol. 6). In the East Mau, small human centers grew in relation to the cultivation of tree plantations through a system known at the time as Taungya, predecessor of today's PELIS (see sub-chapter 5.2; see the cartography of East Mau, 1967). The protected area was also subject to cycles of migration from neighboring districts of the Rift Valley Province that occurred when rumors of possible permanent land allocation spread through the country, as in the 1980s in Southwest Mau (RVPA, FOR 13/5 Vol. 6 and 7) or at times of ethnic and political unrest, as occurred during the 1992 elections (Daily Nation, 1993; Moorehead, 1993).

In the Mau Forest Complex, the government intended to allocate two big portions of the forest reserves to the creation of the settlement schemes of Saino, Ndoinet, Tinet, and Kiptagich Extension in the Southwest Mau (25,000 ha)[8] and of Baraget, Mariashoni, Nessuet, Sigotik, Teret, Sururu, and Likia in the East Mau (35,000 ha)[9]. The initiative was identified as the "Wadorobo Resettlement Programme" as an indication of its official purpose to settle the Ogiek groups and the people affected by political violence (Mau Forest Task Force, 2009) and was guided by the District Administration of Nakuru. Despite

7 "Ndorobo" or "Dorobo" was a derogatory nickname used by the Maasai people in referring to the people currently known as Ogiek. This name was adopted by the colonial government to generically refer to the hunter-gatherer groups in the colony. Today, in the Mau region members of this group call themselves "Ogiek".

8 These settlement schemes were anticipated by the establishment within the boundary of the Southwest Mau of the Korau Settlement schemes (2,733 ha) with a forest excision in 1985.

9 See the archival documents located at the RVPA, FP 8/7 C3/NE/SU/GE; FOR 13/5/1 Vol. 2; FOR 13/5/1 Vol. 3; FP 8/27 LA/RVP/122.

the title, the program concealed a very specific political intent—the alteration of the ethnic composition of the district aimed at strengthening political support for President Moi (Klopp, 2012). During the years, thousands of Kalenjin people (the same ethnic group as President Moi) looking for land came from the neighboring Rift Valley districts (Kericho, Bomet, Baringo, and Eldoret) and settled on Mau land. While this left the Ogiek with a sense of injustice suffered in seeing their ancestral land allocated in large amounts to outsiders, the forest land redistribution to Kalenjin families would have worked to strengthen the political power of the KANU government in the district.

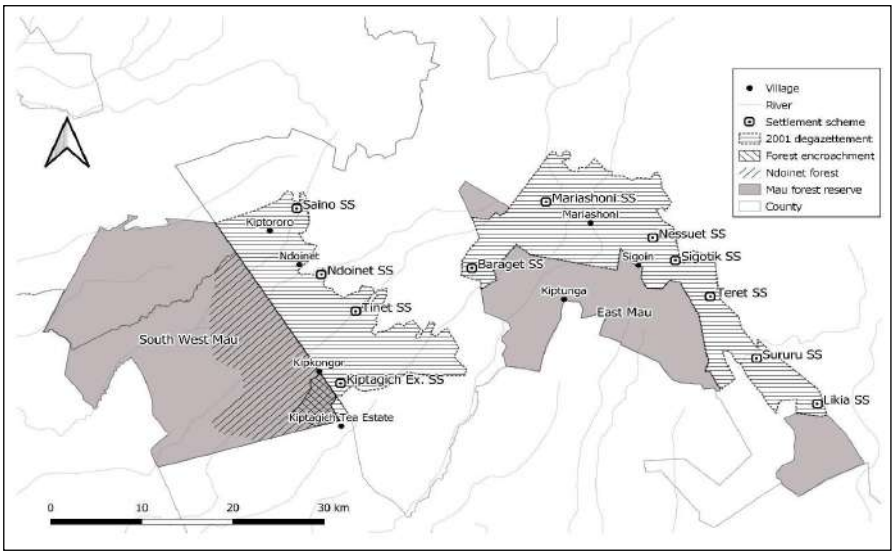

Fig. 2.2 - Mau forest settlement schemes (edited by the authors, GoK and UNEP, 2008; Department of Survey, 2018; Department of Resource Surveys and Remote Sensing, 2019)

The creation of Mau settlement schemes in the 1990s coincided with a political transition in the country (1992–2002) from an authoritarian one-party system centered on President Moi (1978–2002) to a plurality of political parties (Hornsby, 2012). It was a decade of crisis triggered by the imposition of so-called "good governance" reforms by western donors in sub-Saharan African countries (Beekers and van Gool, 2012). The repercussions of this regime change would have been felt in the climate of inter-ethnic tension (the political violence of 1992 and 1997) and in the management of natural resources. Land was allocated to build consensus in the Kalenjin electoral base to create new constituencies and to benefit the ruling elite (as in the case of the Kiptagich Extension settlement scheme) in order to forge personal alliances between politicians, businessmen, administrators, and the military (Commission

of Inquiry into the Illegal/Irregular Allocation of Public Land, 2005; Boone, 2012; Albertazzi et al., 2018; Cavanagh, 2018).

During the 1990s, the land allocations continued uncontrolled for some years and went far beyond the designated areas, resulting in a severe impact on Mau Forest cover. Furthermore, the allocations led to the eviction of those who were settled on Mau Forest land and who lived in the most diverse situations—from those who possessed land allocation documents to those who were simple squatters awaiting some sort of amnesty. Since 2013, there has been a caveat regarding the settlement areas of Mau that prevents the erection of permanent structures and prohibits commercial transactions on the land. As a consequence, those who live in settlement schemes and have not received property titles in the past find themselves in possession of a frozen asset that places them in a fragile situation. Due to this intricate past made up of the occupation of forest land, forced evictions, and settlement validations documented and then challenged, Mau's settlement schemes are an extremely sensitive topic from a political and an ethnic point of view.

3 Deforestation in the Mau complex: a remote sensing analysis

3.1 General overview

The three forests have undergone different deforestation processes, very limited in the Koibatek Forest and more intense in the Kiptunga Forest and the Ndoinet Forest. The decisive change occurred in the 1990s when 60,000 ha of forest land (14% of the Mau's protected area) were converted to settlements (see sub-chapter 2.3) and then legally sanctioned through the 2001 degazettement (GoK and UNEP, 2008). To understand the complex deforestation process that characterized the central sector of the Mau complex, we conducted a remote sensing analysis using satellite imagery of the Southwest sector.

Land cover changes can be caused by long-term natural climate change, ecological and geomorphological processes, human-induced vegetation and landscape transformation, and inter-annual climate variations. Each of these phenomena manifest at different scales, have different intensities, are characterized by a certain degree of reversibility, and produce a specific effect on environment and society (Lambin and Ehrlich, 1997).

One ways these changes can be investigated is through remote sensing analysis, the collection of information about an object on the Earth's surface without direct physical contact with it, for example using satellite images[1]. Satellite imagery provides three levels of information for the study of forests. The first is land cover dynamics, thanks to the different spectral responses of forest and non-forest areas, and the possibility of detecting fires and burn marks on the ground. The second concerns the type of forest, which is mostly defined by the tree canopy, thus distinguishing, for example, tree plantations from indigenous forests. The third is to gather information on biophysical and biochemical properties that give indications regarding the quality of forest resources. Some of the most used indices are the Simple Ratio, the Normalized Difference Vegetation Index, and the Leaf Area Index (Boyd and Danson, 2005). Thus, it is possible to estimate the amount of biomass, the degree of biodiversity, and the impact of drought on forest areas (Foody, 2003).

1 A crucial role in this sense was played by the launch in 1972 of the Landsat program (by the National Aeronautics and Space Administration and the US government), while the European Space Agency and the European Union undertook the Copernicus–Sentinel program in 2015.

At the end of the 1980s, Myers (1988) stressed the great opportunity of using remote sensing in the study of deforestation, highlighting the possibility of having systematic and objective data. While this is true, many methodological issues may affect the analyses. Lambin (1999) suggested a meticulous approach to the study of forest degradation at a regional level, with the aim of avoiding errors in monitoring due to ecological reversibility and the strong impact of climatic variability that plays an important role in Africa south of the Sahara.

Since the 1990s, it has been possible to measure forest changes using satellite imagery. There are many studies investigating forest area changes (Sánchez-Azofelfa et al., 2001; Zhang et al., 2005; Torahi and Rai, 2011; Folega et al., 2014; Pellikka and Alshaikh, 2016). Some of these studies do not limit themselves to surveying land conversion but relate this to different variables, such as biophysical variables (e.g., slope, altitude, soil type, vegetation, rainfall, and hydrology), demographic variables (e.g., population growth), and economic variables (e.g., distance to markets, land price, and agricultural subsidies) (Chowdhury, 2006; Reis, 2008).

3.2 Methodology

The analysis of the satellite images was carried out in two steps, a visual interpretation of the satellite images in false colors and a land cover supervised classification[2]. Six Landsat satellite images (30x30 m resolution) were used, covering the significant years of 1986, 1995, 2000, 2003, 2008, and 2014, and a Sentinel image (10x10 m resolution) was used for 2019. The images for each year were taken in the dry season between January and the beginning of April, which is preferable due to the marked contrasts between the forest vegetation and the land being worked for sowing (in the case of maize, the main crop in the area). It is also the time period in which most of the fieldwork was conducted and therefore suitable for the use of global positioning system (GPS) points taken on the ground.

After the image acquisition, pre-processing was carried out, which consisted of rectification, atmospheric corrections, and topographic normalization[3]. Finally, a multispectral image was created for each year of classification consisting of 13 layers—layer/bands 1–6 (band 1 = blue, band 2 = green, band 3 = red, band 4 = near infrared, band 5 = short-wave infrared, band 6 = thermal

2 In this chapter, we will mainly show the quantitative results of the supervised classification (Fig. 3.8 and Table 3.1) to understand the cover changes of the three different classes used in the analysis.

3 These processes were conducted by Dr. Hari Adhikari (University of Helsinki), who is also credited with the design of the supervised classification procedures adopted in this analysis.

infrared), layer 7 = NDVI, layer 8 = TCT 1, layer 9 = TCT 2, layer 10 = TCT 3, layer 11 = RSR, layer 12 = SAVI, and layer 13 = NPVND[4].

False-color images were then analyzed to guide the visual interpretation of deforestation processes. The false-color images result from the variable combination of three bands, the use of which is frequent in forest studies to detect the differences between areas with dense vegetation and grasslands or agricultural fields. In particular, we are showing multispectral maps in false colors (4 red [R]), 3 (green [G]), 2 (blue [B])[5]. The multispectral map displayed later is a classic false-color representation in which the vegetation is bright red because the green vegetation in good condition brightly reflects band 4 (NIR)[6].

Regarding land cover classification (see an example in Fig. 3.1), the starting hypothesis considered deforestation as the result of an expansion of human settlements, attested by the presence of crops within the protected area. Therefore, it was decided to use three land cover classes—dense forest, transition forest, and cultivated/bare soil. The class "dense forest" represents closed canopy cover, an indication of the presence of primary forest. The class "transition forest" includes bamboo forest, shrubs, and grasslands. The class "cultivated land/bare soil" indicates the presence of crops or soil not covered by vegetation, such as land awaiting sowing and erosion areas[7].

For the Landsat analysis, considering the impossibility of collecting a large number of GPS points directly in the field in different areas of the forest sector, it was decided to simulate the presence of the operator using high-resolution images from Google Earth, with 2014 as the reference year. This decision was motivated by the fact that in the last 5 years the Southwest Mau sector has enjoyed a stable situation, and there has been no acute loss of area. Furthermore, the classification of past years' land cover for the study area is difficult due to the lack of maps, GPS surveys, and historical Google Earth images with good

4 NDVI stands for Normalized Difference Vegetation Index and is calculated as the ratio of the difference to the sum of the reflected radiation in the near infrared and red. TCT stands for Tasseled-Cap Transformation and is a conversion of some values present in the bands and useful in studies of vegetation changes; TCT 1 refers to soil brightness, TCT 2 to the degree of greenness of vegetation, and TCT 3 to the moisture present in the soil. RSR stands for Reduced Simple Ratio, SAVI for Soil-Adjusted Vegetation Index, and NPVND for Non-Photosynthetic Vegetation Normalized Difference.

5 In the overall analysis we also used multispectral images in false colors for short infrared (SIR), near infrared (NIR), and red (R) bands and multispectral images in false colors for NIR, SIR, and blue (B) bands.

6 The false-color image 4, 3, 2 is given by the display of the near infrared (NIR), red (R), and green (G) bands.

7 The classification followed two different processes. We used the software ERDAS Imagine 2015 for Landsat images and the Semi-Automatic Classification Plug-in available in Qgis for the Sentinel image. In both cases, were also used Qgis Version 3.8 and Office Excel to work on data.

resolution, which makes it impossible to derive points to use in the classification of pre-2014 years.

Next, 1000 points were manually selected on Google Earth (2014 reference image) and assigned to one of the three classes. The 1000 points of the year 2014 were then associated with the values of the vegetation bands and indices present in the normalized raster image for 2014. Finally, 70% of the points were used as training points and 30% as test points. Thus, six Excel files were obtained for each year of classification, two for each class (i.e. "training points" and "test points"); altogether, 6,000 points were screened.

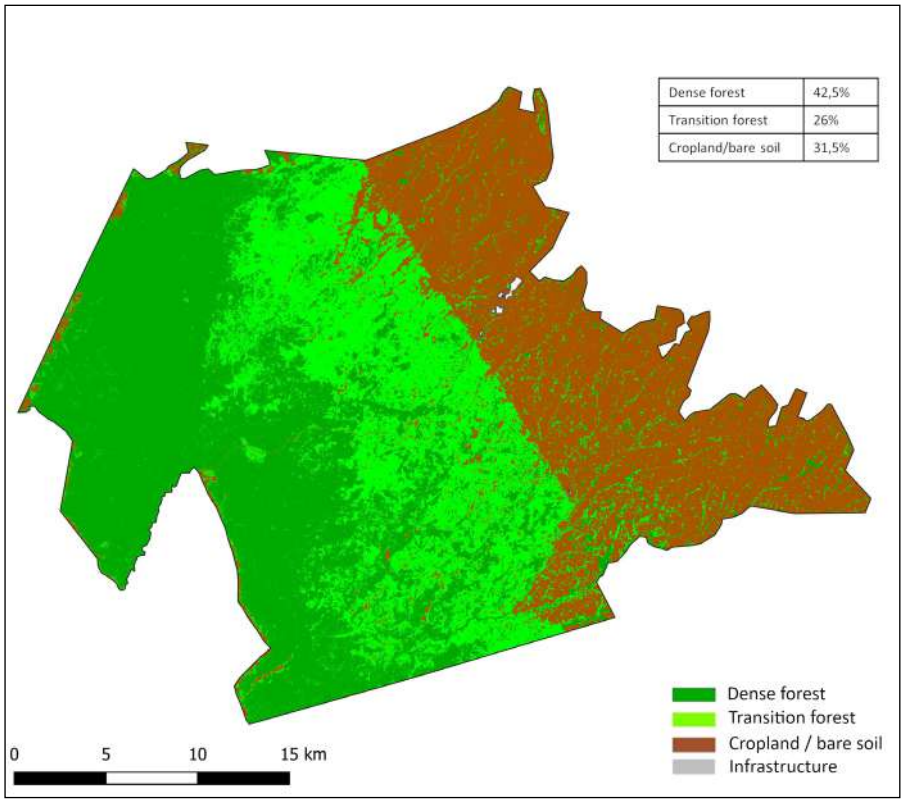

Fig. 3.1 - Example of land cover classification, 2019
(source: Stefania Albertazzi, 2020)

As the points belonging to the same area have the same spectral signature, it is possible to notice the presence of one or more trends for each class and to take advantage of this property. Therefore, one possible method to conduct a multi-temporal supervised classification is to use the spectral signature trends of each class of the 2014 image as a reference. It is then possible to eliminate those points that in previous years show a trend differing from that of the class

to which the Excel file belongs, which means that in the year under consideration that point did not belong to the class to which it belongs in the 2014 reference year. In this way, it is possible to detect changes in the land cover of the point. In the end, the final points of each class—that is, after eliminating all points with a trend differing from that of the class in the Excel file—are then loaded into the software and will serve as training and test points for the classification.

3.3 The case of the Southwest Mau Forest sector

The research covered the whole Southwest sector, of which the Ndoinet Forest section is part. The total area before the 2001 excision of the eastern portion (25,000 ha) was about 85,000 ha. As our hypothesis ascribes forest loss to the conversion to crops, our analysis focused on highlighting the presence of agricultural land or land not covered by vegetation within the forest reserve. The visual interpretation of satellite images can provide useful insights regarding the unfolding of the process.

1995

The false-color image (Fig. 3.2) depicts the primary forest in dark red, the bamboo forest and shrubs in less bright red/purple, and the land without vegetation in light blue. These may indicate eroded areas, the presence of which is frequent along the forest slopes, or areas where forest vegetation is absent due to the presence of human settlements or cultivation (which in the month of the image survey are being worked in preparation for sowing and are therefore without cover). The image informs us of the state of the forest in the mid-1990s, a period for which few sources are available. The forest sector is not a single continuum of primary forest, and the vegetation varies between the western, central, and eastern sections, where there is evidence of human presence. In particular, in the central–eastern edge of the sector, an area of 2,733 ha known as the Korau Settlement Scheme (see subchapter 2.3) had been devoted to the settlement of about 700 people in 1985. This was the first official population settlement within the Southwest Mau sector and can be considered a sort of anticipation of the following settlement schemes that would be created by the government in the 1990s.

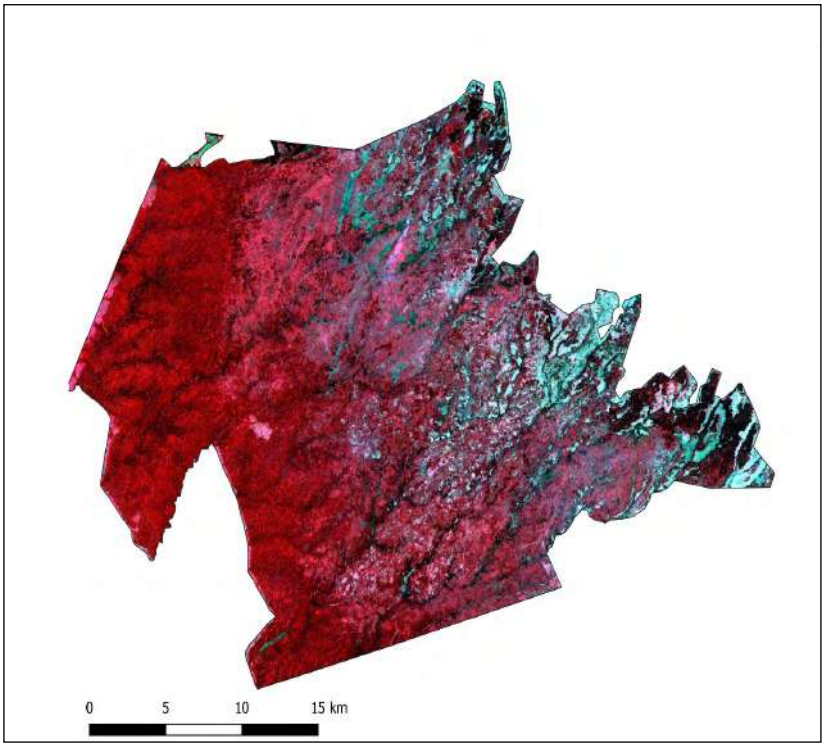

Fig. 3.2 - The Southwest Mau in 1995 (source: Stefania Albertazzi, 2020)

2000

In the false-color image (Fig. 3.3), as in the previous one, the dense forest is represented in dark red, the secondary forest (with shrubs and bushes) in less bright red/purple, and the land without vegetation cover, such as bare soils or agricultural land, in light blue. This is a fundamental image to understand the deforestation process of the Southwest sector. The situation looks very different from 1995. The eastern section suffered a drastic change, and the expansion of agriculture seems to be starting in the south, although it appears more scattered than in the northern areas. In 2001, the Minister of the Environment announced the official degazettement of the eastern section, the legal modification of the boundary, and the allocation of degazetted areas to settlements, for a total of approximately 25,000 ha. The Southwest Mau was reduced to approximately 60,000 ha.

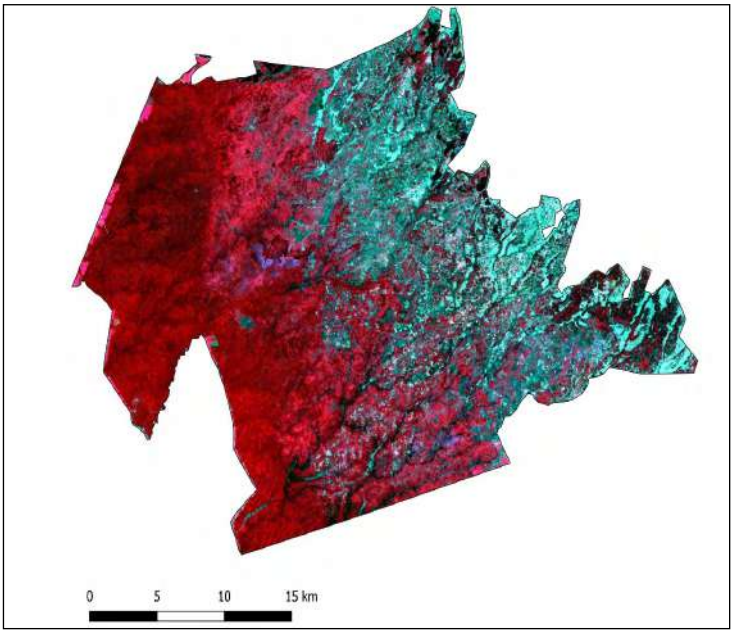

Fig. 3.3 - The Southwest Mau in 2000 (source: Stefania Albertazzi, 2020)

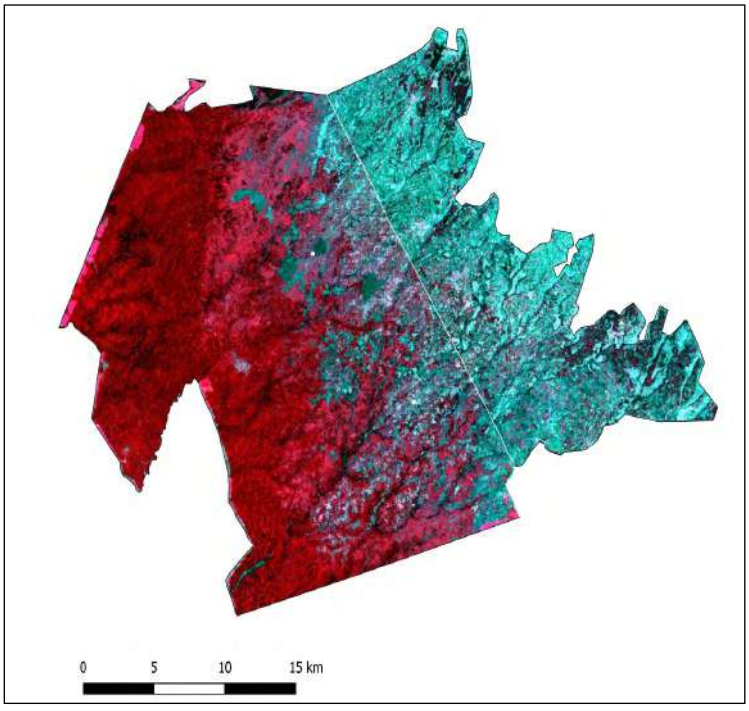

Fig. 3.4 - The Southwest Mau in 2003 (Stefania Albertazzi, 2020)

2003

The false-color satellite image (Fig. 3.4) illustrates the land cover changes that occurred with the progressive settlement of people in the eastern section of Southwest Mau. To the east of the 2001 boundary (represented by the white line), the forest areas (dark red) are almost non-existent; a few exceptions are located on the fringes along the edge of what was the previous boundary.

The alarming data concerns the strong pressure that remains on the forest despite the recent degazettement of the eastern section. The widespread presence of light blue and blue/dark green spots indicates extensive areas without forest cover west of the 2001 boundary. The presence of agriculture or bare surfaces within the protected area is recorded at a distance of 9 km from the boundary in the northern area and 14 km from the boundary in the southern area.

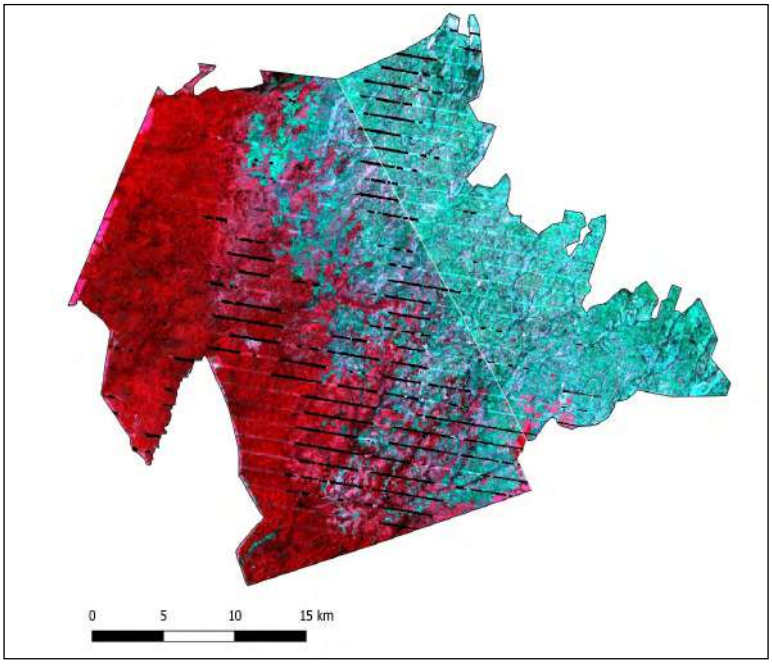

Fig. 3.5 - The Southwest Mau in 2008 (source: Stefania Albertazzi, 2020)

2008[8]

The false-color image (Fig. 3.5) captures the worst state of the Southwest Mau over the past three decades. The loss of forest area (dark red) west of the border (white line) reaches its maximum. The eastern part of the protected area, the core of what is now the Ndoinet section, is completely devoid of tree

8 The white stripes on the image are due to a problem with the sensor of the Landsat 7 satellite.

cover. The area lying between 5 km and 10 km from the border is an extensive area without tree cover (in light blue) interspersed with a few forest spots. This forest loss is the result of spontaneous encroachments of the population that lived on protected land in the wake of previous amnesties. The emergency situation focused the attention of the UNEP and of the Kenyan government on creating the premise for the future launch of the Water Towers Initiative, the program for the rehabilitation and protection of mountain forests that serve as the country's water reservoirs. East of the 2001 boundary (white line), in the settlement area, we record a total absence of tree cover.

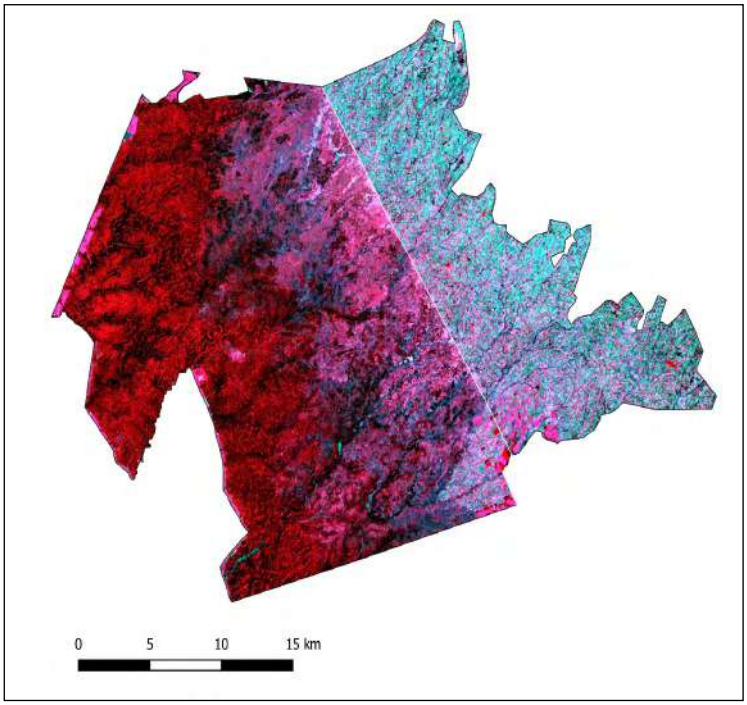

Fig. 3.6 - The Southwest Mau in 2014 (source: Stefania Albertazzi, 2020)

2014

The false-color image (Fig. 3.6) represents the end of the emergency situation. West of the boundary (white line), we can see the regrowth of forest vegetation (in purple), interspersed with light blue patches that represent the traces of previous encroachments that have ended. Nevertheless, an uncertain situation remains in the southern end of the forest sector, where the boundary of the protected area is unclear and the presence of agriculture is recorded.

East of the border, in the settlement area, the situation seems to be improving as well, compared to previous years. We note the widespread presence of

forest patches (in purple), a sign of the reforestation that is taking place along the waterways and of the spread of private woodlots on farms.

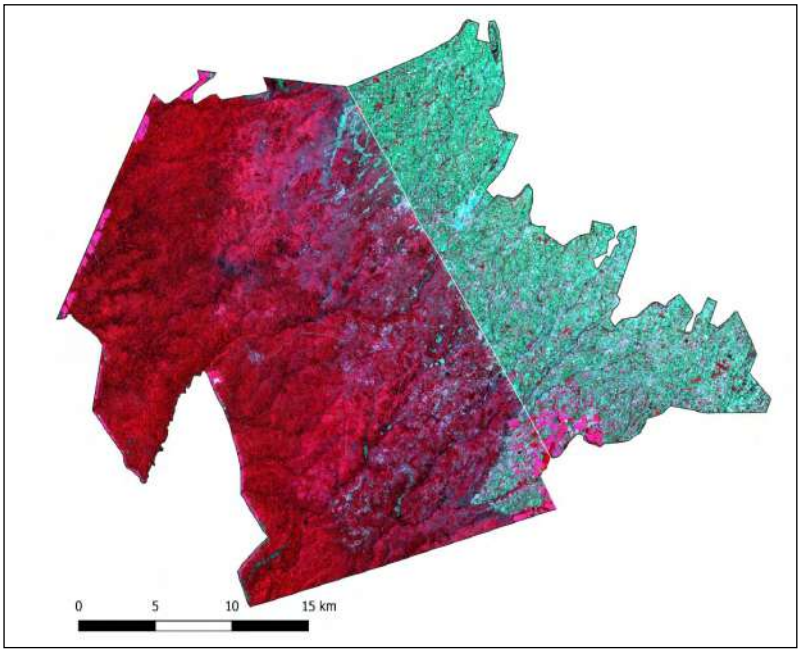

Fig. 3.7 - The Southwest Mau in 2019 (source: Stefania Albertazzi, 2020)

2019

The false-color image (Fig. 3.7) is a recent photograph of the situation of the Southwest Mau. The forest reserve continues in the positive trend that was visible in the 2014 image. The dense forest (dark red) and the secondary forest (light red/purple) are expanding, while several eroded areas can be seen within the reserve (in light blue). The southern edge of the forest sector is still affected by the presence of agriculture, a sign of an unclear boundary and of unresolved land issues.

East of the border, in the settlement area, the positive reforestation and the spread of private woodlots that had been observed 5 years earlier seem to have diminished. This is worthy of attention, as reforestation in the settlement areas is critical for the protection of the streams that cross the forest reserve and that have their sources in the upstream settlements. Furthermore, the presence of private woodlots on farms has significant implications for the pressure exerted by the population on the protected area regarding the collection of firewood because it reduces the community dependence on forest resources and defuses a potential threat to the forest.

Discussion

Using the maps resulting from the land cover supervised classification, it is possible to estimate the area of each class to produce a diachronic picture of changes in forest cover in the Southwest sector and compare it with the other sources used in this research[9]. It is worth remembering that since 2001 the boundary of the forest reserve has been changed. The years 2003, 2008, and 2014 keep representing the original extension, even if the eastern section was degazetted in 2001 and converted to settlements.

The graph and the table below show the area (ha) of each class and the corresponding percentage compared to the total extension of the forest sector (84,685 ha).

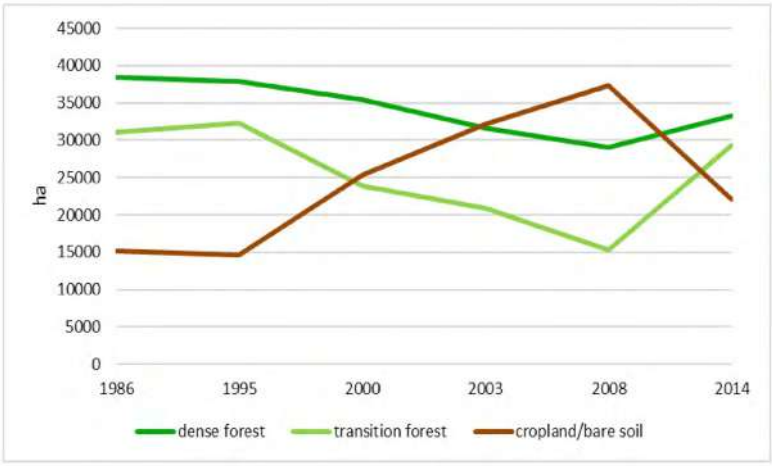

Fig. 3.8 - Variations of land cover in the Southwest Mau, 1986–2014 (source: Stefania Albertazzi, 2020)

The graph informs of two key moments in the history of the forest, namely 1995 and 2008 (Fig. 3.8). In 1995, a symmetrical trend of loss of forest ("dense" and "transition") and growth of the "cultivated/bare soil" class started, culminating in 2008 when a reversal trend began.

Since 1995, the "crops/bare soil" class has experienced a steady increase from about 14,500 ha to about 37,000 ha in 2008. This figure is consistent with the events previously mentioned. In the period 1996–2001, the creation of government settlement schemes within the boundary of the protected area took

9 The land cover classification accuracy assessment, resulting by the cover class correspondence of training points and test points, is 91,74% for 2014; 89,18% for 2008; 91,71% for 2003; 97,18% for 2000; 92,67% for 1995; 95,27% for 1986.

place, while in 2008 awareness of the deforestation process emerged, creating the basis for the launch of the rehabilitation and conservation phase.

The "transition forest" class seems to be the class most affected by the expansion of cultivation. This data informs us that the deforestation process has mainly affected this type of forest cover, which experienced the greatest impact in 2008, with its surface area at about 15,000 ha compared to about 32,000 ha in 1995. The "dense forest" class seems to be the least affected by the changes in cover, with an area of about 29,000 ha in 2008, the year of greatest loss, compared to about 38,500 ha in 1986.

Considering the percentage changes in class composition, it is confirmed that the "dense forest" class was the least affected by the deforestation process, suffering a maximum of a 9.9% decrease (1986–2008) and a 6.1% loss in the overall period 1986–2014. The class "transition forest" experienced a maximum change of -19.4% (1995–2008) and a total loss of 2.2% compared to 1986 and 2014 values. The class "crops/bare soil" experienced a maximum increase of 28.5% (1995–2008) and an 8.2% gain in the whole period.

Table 3.1 - Land use change by class area, 1986–2014
(source: Stefania Albertazzi, 2020)

Year	Dense forest	Transition forest	Cropland/bare soil
1986	45,40%	36,70%	17,90%
1995	44,80%	38,10%	17,20%
2000	41,90%	28,20%	29,90%
2003	37,30%	24,70%	38,00%
2008	35,50%	18,70%	45,70%
2014	39,30%	34,50%	26,10%

The table underlines the relevance of the years 1995 and 2008. In the former, about 45% of the entire Southwest Mau is occupied by "dense forest", while in 2008 the same percentage represents the presence of "crops and bare soil". The year 2014 seems to indicate the establishment of a reversal in the deforestation process, following the implementation of protection and restoration measures for the Mau complex.

In conclusion, we can highlight three major points concerning the deforestation process in the southwest sector of the Mau Forest. First, the proximate cause of the deforestation that hit the forest sector is to be found in the conversion of forestland into settlements. From 1995–2008, the agricultural front proceeded from the eastern edge of the forest reserve towards the west at the expense of forest cover.

Second, the loss of forest area started from 1995 and became an emergency in 2008. From that year, the situation improved and was marked by a process of regeneration that concerned the forest reserve and the settlements (for a certain time).

Finally, the Ndoinet Forest section was strongly affected by the human occupation following 2001. Compared to the entire Southwest Mau sector, this portion of forest was largely converted into agricultural land and experienced a massive human presence until 2008. There is still evidence of this in the forest vegetation, in particular in the abundant presence of grasslands and shrubs, a direct result of human action on nature.

4 Wildlife

The Mau Forest, one of the few remaining forests in east Africa, has a remarkable heritage of animal biodiversity. One of the objectives of our research was the participatory mapping of local homeotherm wildlife. The communities living around the forest were directly involved in the process of recording the species present in the area, mapping their ranges at a local level and overlapping them to identify hotspots of species richness and conservation value. The methodology was adapted by the World Wildlife Fund (WWF)'s global work of ecoregional assessment (Dinerstein et al., 2000) and subsequent applications at a more local scale (Bogliani et al., 2009; Pompilio et al., 2018), with a reduction in terms of the scale of chosen *taxa* (from classes or macro-groups to single species) and of the study area (from the continental level to the local level).

In the three forests, the participatory mapping work was always divided into two phases—data collection through focus groups and transect forest walks, while a camera-trap sampling session was added in Kiptunga. Before the mapping exercise, the informants (on average, 15–20 per site, both genders represented, with a majority of men) were asked to locate their house on a map to test their ability to read it. The three rapid biodiversity assessments were carried out by asking the community to list and locate the species thought to be present. The assessments focused only on homeotherm fauna (mammals and birds), as the main aim of the work was to use a few taxa as indicators of ecological integrity rather than a complete zoological checklist.

For game wildlife and other mammals, informants were able to draw a polygonal range at a local level. For every bird species, we asked informants to indicate one to three locations where they spotted the species, finally getting a monospecific cloud of points comparable to a polygon. An initial checklist of bird species was selected by intersecting two different criteria. The first was the list of the birds detectable in the Important Bird Area[1] of the Mau Forest Complex, and the second was a forest quality indicator based on Bennun et al. (1996), who clearly divided a list of forest birds from Kenya and Uganda into three categories of sensitivity to the forest habitat quality. The sample shown to the population was a set of birds of high-quality forest, plus a few species of lower habitat quality used as a control. Informants were not made aware of Bennun's ecological distinction during the data collection in order to avoid any influence in the process of localization of the species.

For mammals, the original checklist was simply based on species potentially present in the area, based on relevant literature on the actual or recent distribution of the species (Rodgers et al., 1982; Kingdon, 1997; IUCN, 2016).

1 The Mau Forest Complex is the Important Bird Area KE051, as listed by Birdlife International.

Informants were first asked to confirm or deny the presence of the species from the original list in the forests. In order to ensure an individual's ability to recognize the species, all of them were identified in the local language. In the different sectors of the indigenous forest and in the area dominated by tree plantations, the community was then asked to give an index of "detectability" of each species or of the ecosystem service enjoyed. The latter refers to the benefits that people get from ecosystems and relates to natural products (firewood, fruits, water, etc.) or cultural value (aesthetical, spiritual, etc.) or regulating activities (for water and air regulation, pollination, etc.) (MA, 2005; see chapter 8). The index value ranges from 0 if absent, to 1 if rare, and to 2 if common. As the index is a potentially subjective indicator, no value was accepted before it was agreed by the whole group of informants (n = 15–20, depending on the forest), thus representing the result of a common discussion.

The average probability across all forest areas was used to rank species according to sensitivity, and the average value across the species was used to estimate the degree of the ecological integrity of the forest sectors. The community was asked for some additional information about their *perceptions* regarding population trends, utility (e.g., food, commerce), the level of human–wildlife conflict, and the hunting of single species. Hunting is illegal within the protected area but is still practiced by local communities, although it is difficult to assess with what intensity. Once the data collection phase was completed, some visits were made to the forests with local informants to detect direct or indirect animal signs, such as feces, fur, or footprints. In addition, some camera traps were placed in Kiptunga.

4.1 Koibatek Forest

The Koibatek section was divided into four main zones—the southern area, where the temporary agriculture of the PELIS program (see below, chapter 5) prevails; the north-eastern area dominated by shrubs due to recent fires (together defined as impacted areas); the central and forested area; and the western area where bamboo prevails (later defined as not impacted areas). In the field, the Kiptuget Forest area immediately north of the Koibatek section was also considered an influential ecological factor. In fact, the Koibatek Forest is the southern part of an ecosystem that has its core in the Kiptuget Forest, and wildlife populations from the two forests are likely to be connected as a whole. Analyzing the deep forest means, ecologically speaking, to take into consideration the potential return of locally extinct wildlife under an adequate level of protection, and it is therefore of strategic value in terms of restoration. However, the Koibatek Forest acts as a buffer area for this deeper forest, which probably represents the true ecological value of the whole area and which should be protected through the adequate management of the buffer area.

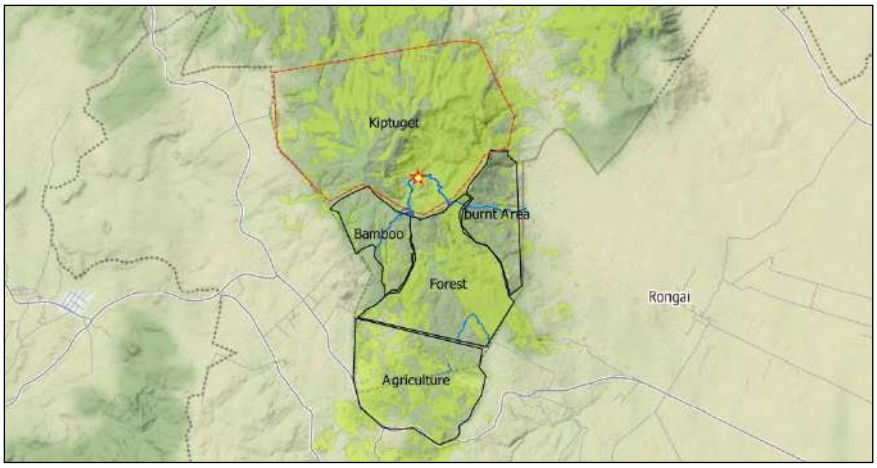

Fig. 4.1 - Koibatek Forest map resulting from a participatory workshop (Trivellini, 2018). The blue line and the star indicate the footpath taken with community informants during a forest walk; the red line indicates the Kiptuget Forest extension; and the black lines indicate the boundaries of each section.

Mammals

The results of the focus group on the mammals are summarized in Table 4.1. In particular, we can highlight three main aspects. First, from the original checklist of 32, the community confirmed only 15 species as present (plus an undefined group of rodents). Out of 16 elements, 12 have a kind of utility for the community (the informants indicated a direct use for 11). All species with a decreasing population trend (or undefined due to rarity, such as the forest hog (*Hylochoerus meinertzhageni*), were game species or carnivores that create conflict (serval, *Leptailurus serval*). Of the 16 species, 11 (69%) show a certain form of conflict with human activities, and 6 out of 8 (75%) of the increasing species conflict with agriculture, as their range overlaps with farming areas.

The elephant (*Loxodonta africana*) and the forest hog, whose presence depends on the thick forest habitat, are defined as uncommon and can only be found in indigenous forest areas. The most detected species was the bushpig (*Potamochoerus larvatus*), which can live in agricultural areas and poses serious problems for crops (Seydack, 2013). The Harvey's red duiker (*Cephalophus harveyi*), a game species typically linked to a forest habitat, was more common in less impacted areas, while the olive baboon (*Papio anubis)*, the blue monkey (*Cercopithecus mitis*), and the black and white monkey (*Colobus guereza*) were described as very common, as in the rest of the Mau Forest. In addition, the bongo (*Tragelaphus eurycerus*, IUCN Near Threatened) and the buffalo (*Syncerus*

Table 4.1 - Mammals species in Koibatek Forest according to the community informants (Trivellini, 2018)

Classification					Relationship with the community				Detectability Index				
Order	*Species name*	English name	Local name (Kalenjin; Kikuyu)	IUCN	Utility for the community	Human-wildlife conflict	Perceived population trend	Causes of perceived variation	Farming area	Bamboo area	Burnt area	Forest	Average
Artiodactyla	*Cephalophus harveyi*	Harvey's red duiker	Mindet	LC	Food	None	Decrease	Hunting	0	0	1	2	0,75
Artiodactyla	*Hylochoerus meinertzhageni*	Forest hog	Tumda	LC	Food	N.A.	N.A.	N.A	0	0	0	1	0,25
Artiodactyla	*Madoqua kirkii*	Dik dik	N.A.	LC	Food	N.A.	N.A.	N.A	1	1	1	2	1,25
Artiodactyla	*Potamochoerus larvatus*	Bushpig	Toret	LC	Food	Crop destruction	Decrease	Habitat loss	1	2	2	2	1,75
Carnivora	*Leptailurus serval*	Serval	Kesogororet	LC	N.A.	Crop destruction, predation on sheep and goat	Decrease	Hunting	1	0	1	0	0,5
Carnivora	*Mellivora capensis*	Honey badger	Kokto	LC	Predation on dangerous snakes	Beehive destruction	Constant	N.A	0	0	1	1	0,5
Hyracoidea	*Dendrohyrax arboreus*	Tree hyrax	Nderit; Getore	LC	Food, traditional attire	Noise	Increase	Reduced hunting	1	1	0	2	1
Hyracoidea	*Procavia capensis*	Rock hyrax	Kipkoiyat	LC	Food	None	Increase	No disturbance	0	0	2	0	0,5
Primates	*Cercopithecus mitis*	Blue monkey	Tisiet; Ngima	LC	Traditional attire	Crop destruction	Increase	Anthropophilous species	1	1	2	2	1,5
Primates	*Colobus guereza*	Black and white colobus	Koroitiet; Nguyo	LC	Traditional attire, tourist attraction	Crop destruction, tree debarking in plantations	Increase	Not hunted	2	1	0	2	1,25
Primates	*Papio anubis*	Olive baboon	Moset; Nugu	LC	N.A.	Crop destruction	Increase	Reintroduced	1	1	2	2	1,5
Proboscidea	*Loxodonta africana*	Elephant	Beliot	EN	N.A.	Crop destruction	N.A.	N.A	0	0	0	1	0,25
Rodentia	*Heliosciurus rufobrachium*	Red-legged sun squirrel	Koboet; Gaturu	LC	Food, fishing bait	N.A.	Constant	No disturbance	0	0	0	1	0,25
Rodentia	*Hystrix cristata*	Porcupine	Cheswereit; Njege	LC	Food, medicine (spike)	Crop destruction, predation on sheep and goat	Increase	Abundance of resources	2	0	1	1	1
Rodentia	Various SPP	Various rats	Muriat; Mbeya	N.A	N.A.	crop destruction, tree debarking	Increase	Abundance of resources	1	2	1	2	1,5
Tubulidentata	*Orycteropus afer*	Aardvark	Chemengewet; Ngari	LC	Food, material (skin used for bags and straps)	Crop destruction, indirect danger (holes digged later occupied by other species)	Increase	N.A.	1	0	2	0	0,75
Average									**0,75**	**0,56**	**1,00**	**1,31**	

caffer), recorded in other forest sectors as a species very sensitive to human presence[2], were not mentioned in Koibatek.

No significant difference was found in the number of reported species between the four sectors (Steel–Dwass test: pairwise comparisons, p always > 0.05). When clustering the sectors in impacted (agriculture and burnt areas) and unimpacted (bamboo and forest areas) habitats, no difference was found between the groups (Wilcoxon test, W=43, p> 0,05).

Although the indigenous forest was the area with the highest absolute number of species, other areas showed a certain species richness (particularly the burnt area due to the presence of regrowing secondary vegetation). The lowest number of species was detected in the southern anthropized area where PELIS is practiced. The northern area of Kiptuget Forest, previously indicated as a potential home to bushbuck and bongo, was walked in search of wildlife signs and showed traces of several species (Fig. 4.3).

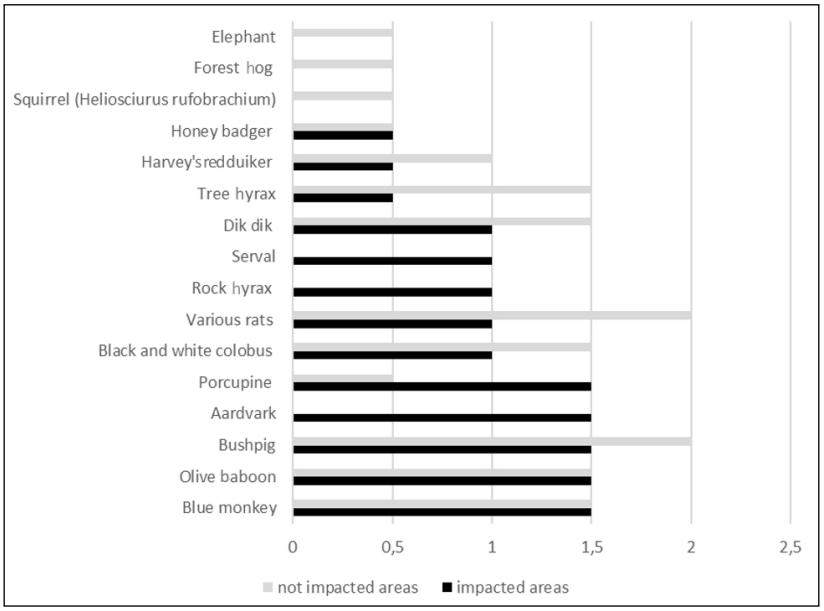

Fig. 4.2 - Mammals ranked by average detectability index in Koibatek Forest, used as a proxy for the sensitivity of the species (impacted versus unimpacted habitats) (Trivellini, 2018)

2 Kiptunga Forest communities have indicated the buffalo as a species that abandons anthropized areas in favor of thicker forest, probably because of its importance as a game species.

Fig. 4.3 - Map of wildlife traces recorded during the forest walks in Koibatek Forest and Kiptuget Forest, with forests analyzed using a remote sensing analysis of the land cover (source: Trivellini, 2018)

Birds

Following Bennun et al. (1996), birds were divided into two groups, a more specialist one (FF), indicator of a higher-quality forest, and a more generalist one (f), indicator of a more anthropized forest. While the first group is biologically expected to be found in the indigenous forest, the second was expected by researchers to be found in the margins or in the most impacted areas.

The mapping work reported the community's idea that birds are rare in the bamboo area and reaffirmed the ecological role of the dense forest (Fig. 4.4). In the more anthropized areas, in the south and northeast, informants reported a mixed ecological situation, with some "high-quality forest" and "low-quality forest" indicator species overlapping. According to the informants, high-quality forest species birds (FF) appeared to be present in degraded (burnt) areas also, while low-quality forest species (f) were almost absent in the indigenous forest.

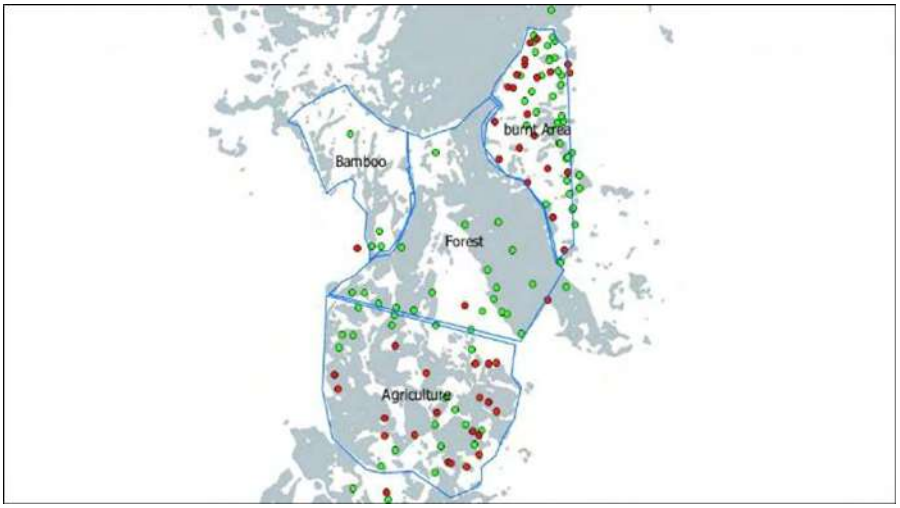

Fig. 4.4 - GIS map of bird species as indicated by community members (Trivellini, 2018). The green dots represent the specialized bird group and the red dots represent the generalist group.

Overall, the picture emerging both from the analysis of the distribution of mammals and birds describes a territory that is much more agricultural than in other sectors in the Mau Forest Complex (e.g., the Ndoinet Forest section).

The human–wildlife conflict revealed by questionnaires mainly concerned agriculture rather than cattle breeding, as almost no large predators were left[3]. Koibatek Forest appeared to be much more anthropized than other study areas. People, in particular, live in the southern area where the forest ecosystem is highly fragmented by tree plantations and crop agriculture, without any relevant contact with wildlife. Most of the species reported to be increasing were smaller size species (medium and small mammals), species of little hunting interest that carry a low level of conflict and therefore are more anthropophilic. The wildlife communities testify to the lack of a real integrity of the landscape, the existence of a residual forest, and a clear anthropic influence in the area of tree plantations and agricultural activities. Species listed by the community were fewer than elsewhere in the research area, and animal biodiversity, especially in the southern agricultural area, appeared to be already compromised.

3 When asked about the presence of the leopard (*Panthera pardus*), the community answered "If we knew that it was present, we would get organized to go and kill it".

4.2 Kiptunga Forest

In the case of Kiptunga Forest, we proceeded in the same way as for Koibatek Forest, asking the local community to list and describe the existing species of homeotherm wildlife. In order to ensure individuals' ability to recognize the species, all of them (18 birds and 21 mammals) were first identified in the local languages, Ogiek and Maasai[4]. For participatory mapping, Kiptunga Forest was divided into six areas—four indigenous forests, Chebuin, Olengape, Kiboyet, and Kaamweu, and two highly anthropized zones (tree plantations and open areas)[5]. The average community index of detectability was used to estimate the likely habitat quality of the different sectors (Table 4.2)

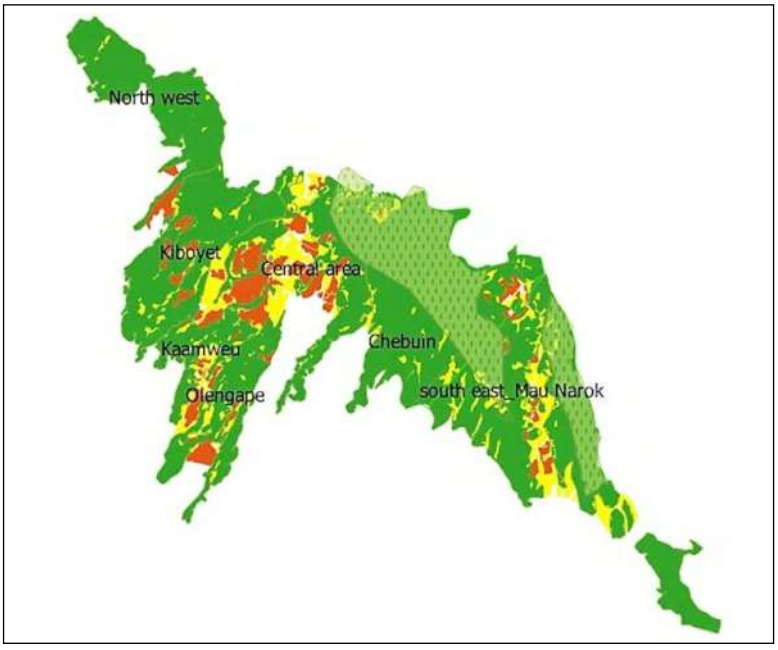

Fig. 4.5 - Map of the Kiptunga Forest edited through aerial pictures (Google maps), fine scale mapping (Original GIS data of the WRI 2007) (Trivellini, 2018): bamboo (light green), indigenous forests (dark green), open areas (yellow), and tree plantations (brown).

Mammals

The results of the participatory survey were coherent for birds, mammals, and provisioning ecosystem services (see chapter 8 below). For the wildlife taxa,

4 To the south, the Kiptunga Forest borders Narok County, mostly populated by Maasai communities.

5 Tree plantations occupy nearly 20% of the Kiptunga Forest section. Agriculture within the protected area is attributable to a few PELIS initiatives and to the fact that within the Kiptunga boundary are located the only Ogiek settlements allowed in Mau Forest.

Table 4.2 - Mammals' detectability index in Kiptunga Forest (Trivellini, 2018)

Classification				Relationship with the community					Detectability Index						
Order	*Species name*	English name	Local name (Ogiek; Maa)	IUCN	Utility for the community	Human-wildlife conflict	Perceived population trend	Causes of perceived variation	Chebuin forest	Olengape forest	Kaamweu forest	Kiboyet forest	Exotic Plantations	cleared (open) areas	Average by species
Carnivora	*Crocuta crocuta*	Hyena	Chemoguguit; Orng'ojine	LC	N.A.	Attacking humans, predation on cattle	Increasing	N.A.	2	2	2	2	2	2	2,00
Hyracoidea	*Dendrohyrax arboreus*	Tree hyrax	Inderit; Enderr	LC	Food, skin	N.A.	Decreasing	Hunting, habitat loss	2	2	2	2	1	0	1,50
Primates	*Colobus guereza*	Black and white colobus	Soiret; Orkoroe	LC	Skin, traditional attire	N.A.	Decreasing	Habitat loss	2	2	2	2	0	0	1,33
Arctyodactila	*Cephalophus harveyi*	Harvey's red duiker	Mindet; Nepirir	LC	Food	N.A.	Decreasing	Hunting	2	2	2	2	0	0	1,33
Arctyodactila	*Tragelaphus scriptus*	Bushbuck	Boinet; Orpuua	LC	Food	N.A.	Decreasing	Hunting	2	2	1	2	0	0	1,17
Tubulidentata	*Orycterpus afer*	Aardvark	Kutet; Oloishiri-dama	LC	N.A.	N.A.	Decreasing	Habitat loss	1	1	1	2	1	0	1,00
Carnivora	*Canis mesomelas*	Black backed jackal	Lelwot; Orbarie	LC	N.A.	Predation on sheep	Decreasing	N.A.	1	1	1	1	1	1	1,00
Primates	*Cercopithecus mitis*	Blue monkey	Tisiet; Orkoluo	LC	Skin	Crop destruction, tree debarking	Decreasing	Habitat loss	1	1	1	2	1	0	1,00
Rodentia	*Lophiomys imhausi*	Crested rat	N.A	LC	N.A.	Holes digging in the farm	Decreasing	Hunting, habitat loss	1	1	1	1	1	1	1,00
Arctyodactila	*Nesotragus moschatus*	Suni	Pechenit	LC	Food	Often found dead for pathologies	Decreasing	Hunting, habitat loss	1	1	1	1	1	1	1,00
Arctyodactila	*Potamochoerus larvatus*	Bushpig	Toraet; Orguya	LC	Food	Crop destruction	Decreasing	Habitat loss	1	1	1	2	0	0	0,83
Arctyodactila	*Madoqua kirkii*	Dik dik	N.A	LC	Food	Increasing ranges	Increasing	N.A.	0	1	2	0	0	2	0,83
Carnivora	*Mellivora capensis*	Honey badger	Kokto; Orpilis	LC	N.A.	Beehives destruction	Decreasing	Habitat loss	1	1	1	2	0	0	0,83
Hyracoidea	*Procavia capensis*	Rock hyrax	Inderit; Enderr	LC	Food, skin	N.A.	Decreasing	Hunting, habitat loss	1	1	1	2	0	0	0,83
Carnivora	*Leptailurus serval*	Serval	Kimelsegutek; Eseperua	LC	N.A.	Predation on sheep	Decreasing	Habitat loss	1	1	1	1	1	0	0,83
Rodentia	*Heliosciurus rufobrachium*	Red-legged sun squirrel	N.A	LC	N.A.	N.A.	Decreasing	Habitat loss	1	1	1	2	0	0	0,83
Arctyodactila	*Cephalophus nigrifrons*	Black fronted duiker	Mindeptegat; Erongo	LC	Food	N.A.	Decreasing	Hunting	1	1	1	1	0	0	0,67
Carnivora	*Panthera pardus*	Leopard	Apiyat; Olowarukeri	VU	N.A.	Attacking humans	Decreasing	Habitat loss	1	1	1	1	0	0	0,67
Primates	*Papio anubis*	Olive Baboon	Mosiot; Oekenyi	LC	N.A.	Crop destruction	Decreasing	Habitat loss	1	1	0	2	0	0	0,67
Rodentia	*Hystrix cristata*	Porcupine	Sapitet; Oyal	LC	N.A.	Crop destruction	Decreasing	Habitat loss	1	1	1	1	0	0	0,67
Arctyodactila	*Syncerus caffer*	Buffalo	Soeet; Oloskwan	NT	Food, skin	N.A.	Decreasing	Hunting, habitat loss	1	0	0	0	0	0	0,17
Average								**1,10**	**1,19**	**1,14**	**1,48**	**0,43**	**0,33**	**0,96**	

the four areas of indigenous forests showed a similar average value of the detectability index, with a crash in anthropized areas (Fig. 4.6). For mammals, indexes were significantly lower than the one recorded in the forest sectors both for the exotic plantations area and the open/grazed areas (Kruskal–Wallis test for multiple comparison, p always < 0,05).

Table 4.2 and Fig. 4.6 show without possible misunderstanding that, according to the community, outside the indigenous forest biodiversity and ecosystem services (see chapter 8) collapse. This means that the population of mammals in Kiptunga could be fragmented and, in the long run, genetically threatened, with possible population reduction and localized cases of extinction (Dixo et al., 2009; Wan et al., 2018; Lino et al., 2019). In a study about forest fragmentation effects on the genetic diversity of different species at different latitudes and longitudes, Lino et al. (2019) found that species with larger body mass are the most negatively affected by fragmentation, that terrestrial and arboreal mammals are more negatively affected than flying species, that herbivores suffer consistent negative effect of fragmentation, and that forest-dependent species are the most susceptible to the negative effects of fragmentation.

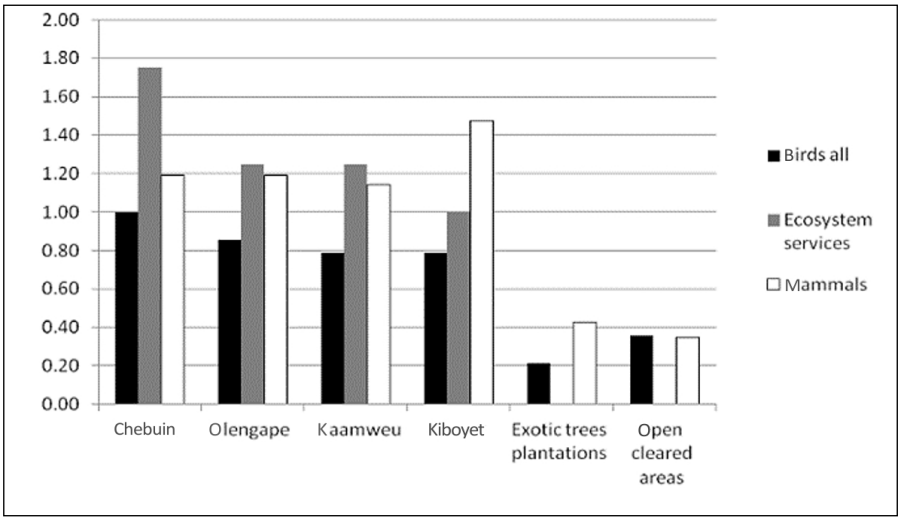

Fig. 4.6 - Average participatory detectability indexes for mammals, birds, and ecosystem services in Kiptunga Forest (see also Albertazzi et al., 2018).

This scenario, applied to the participatory analysis performed in Kiptunga Forest, explains well how the fragmentation of the forest sector could have a relevant impact on the viability of the animal populations of the area. Consistent with this framework, larger game species were reported by the community to have abandoned most of the sector (Table 4.2), remaining only in the largest section of the forest (e.g., forest buffalo, *Syncerus caffer* in Chebuin).

Many species had an average lower index of detectability in impacted areas (Fig. 4.6), and almost all the species were perceived by the community to have a decreasing population trend.

As for Koibatek, participatory mapping data were tested with fieldwork, including transect walks and images collected during a fast camera trapping campaign. Four study areas were sampled—the three indigenous forest areas of Olengape, Chebuin, and Kiboyet, plus small forest patches located in the area with tree plantations (Fig. 4.7). We undertook extensive walks with community members, allowing the collection of qualitative data on animal presence through indirect signs (feces, fur, footprints, and predation signs). Two camera traps were placed in each forest sector at a minimum distance of 150 m from each other and were used for 72 hours (in total eight traps and three days of continuous sampling in December 2013). In total, there were 576 hours of sampling.

The hyena (*Crocuta crocuta*) was detected only in the area of tree plantations, while the bushbuck (*Tragelaphus scriptus*) was detected in all three indigenous forest areas. The hyena is widely considered to be anthropophilic, often following livestock and creating human–wildlife conflicts. It is defined as "an opportunistic carnivore wherever there is animal waste, resulting from feeding other carnivores or humans" (Kingdon, 1997). The bushbuck (as the name explains) is an indicator of a forest habitat. Kingdon (1997) reports the species is "dependent on dense vegetation", while IUCN (2022) describes the species as occurring "wherever there is cover to conceal it".

Moreover, livestock (both sheep and cattle) were spotted in the most anthropized areas—the forest remaining around the tree plantations and Olengape, the most degraded of the three forest areas, and the closest to the most deforested part of Kiptunga.

Considering together data from camera traps and other indirect signs of this rapid sampling session aimed at placing camera traps (a few days of walking), we found just 3 wildlife species in the plantations area and 9 in the forest areas. In the plantations area, we found traces of hyena (*Crocuta crocuta*), warthog *(Phacochoerus africanus*), and blue monkey (*Cercopithecus mitis)*, quite adaptive species living in primary and secondary forests (IUCN red list, 2022). In the indigenous forest area, we found signs of blue monkey, bushbuck (forest sectors of Olengape, Kiboyet, and Chebuin), leopard (*Panthera pardus*, in Kiboyet and Chebuin), black and white colobus (*Colobus guereza,* in Olengape), bushpig (*Potamochoerus larvatus,* in Olengape), aardvark *(Orycteropus afer*, in Kiboyet), and buffalo (*Syncerus caffer*, only in the largest sector of Chebuin). Although the leopard has a large range of habitats in Africa, it remains a large carnivore dependent on a forest environment that provides sufficient cover and higher prey densities (Balme et al., 2007). The buffalo (*Syncerus caffer*), traditionally found all over the Kiptunga Forest, was reported by an elder to nowadays remain only in Chebuin, the largest patch of forest that allows the existence of species now disappeared from smaller forest areas.

Fig. 4.7 - Camera traps positioned in Kiptunga Forest in a fragmented forest patch (rough grain) located close to tree plantations (small grain) (Trivellini, 2018).

Table 4.3 - Camera trap shots and indirect signs of wildlife in Kiptunga Forest (Trivellini, 2018)

Species name	Species	IUCN	Plantations	Olengape forest	Kiboyet forest	Chebuin forest
Crocuta crocuta	Hyena	LC	Camera trap			
Cercopithecus mitis	Blue monkey	LC	Camera trap			Camera trap
	Cattle (domestic)	N.A	Camera trap	Camera trap		
Colobus guereza	Black and white colobus	LC		Direct spot	Direct spot	
Tragelaphus scriptus	Bushbuck	LC		Camera trap	Camera trap	Camera trap
Potamochoerus larvatus	Bushpig	LC	Footprints	Footprints		
Panthera pardus	Leopard	VU			Predations signs (bones)	Footprints
Orycteropus afer	Aardvark	LC			Footprints	
Syncerus caffer	Buffalo	NT				hair on plant
Pternistis squamatus	Scaly francolin	LC				Camera trap
Phataginus tricuspis	White-bellied pangolin	EN			Footprints (holes)	

Table 4.4 - Forest birds used as an indicator of biodiversity in Kiptunga Forest (Trivellini, 2018)

Classification						Relationship with the community				Detectability						
Family	*Species name*	English name	Local name (Ogiek; Maa)	Forest indicator	IUCN	Relationship with the community (utility / conflict)	Perceived population trend	Causes of perceived variation	Perceived habitat	Chebuin forest	Olengape forest	Kaamweu forest	Kiboet forest	Exotic Plantations	cleared (open) areas	Average by species
Accipitridae	*Buteo oreophilus*	Mountain buzzard	Tiepamwarag	FF	NT		Constant		Everywhere	2	2	2	2	2	2	**2,00**
Campephagidae	*Coracina caesia*	Grey cuckooshrike	Pusiendet (Orpus)	FF	LC	Ceremonies / Poisoned by tick medicines	Decreasing	direct kill	Forest and bamboo	1	1	1	1	0	0	**0,67**
Fringillidae	*Crithagra burtoni*	Thick-billed seedeater	Kimugulkutiet (Enkisambu)	FF	LC		Decreasing		Natural tree forest	1	1	1	1	0	0	**0,67**
Macrosphenidae	*Sylvietta leucophrys*	White browed crombec	N.A.	FF	LC		N.A.			1	1	1	1	0	0	**0,67**
Musophagidae	*Tauraco hartlaubi*	Hartlaub's turaco	Merewet	FF	LC	Traditional ceremonies	Decreasing	habitat loss	Tree forest : *Pondocarpus lat.*	2	2	2	2	1	0	**1,50**
Nectariniidae	*Anthreptes rectirostris*	Green Sunbird	Chikiriri/inyonyi/embibi	FF	LC		Constant		Forest edge	1	1	1	1	0	1	**0,83**
Picidae	*Campethera tullbergi*	Tullberg's woodpecker	Kipkongoniet	FF	LC		Decreasing	habitat loss	Tree forest: *Juniperus proc., Olea cap., Podocarpus*	1	1	1	1	0	0	**0,67**
Ploceidae	*Ploceus insignis*	Brown-capped weaver	legorgor (Oldinyoi)	FF	LC		Decreasing		Absent in open areas and bamboo	1	1	1	1	0	0	**0,67**
Pycnonotidae	*Andropadus masukuensis*	Shelley's greenbul	Tistet	FF	LC		Decreasing	habitat loss	Forest and bamboo	1	0	0	0	0	0	**0,17**
Pycnonotidae	*Arizelocichla nigriceps*	Eastern mountain greenbul	Abuyuktet	FF	LC		N.A.			1	1	1	1	0	0	**0,67**
Sturnidae	*Onychognathus walleri*	Waller's starling	Kwaach (Olegishu)	FF	LC	Poisoned by tick medicines	Decreasing	direct kill	Open areas	0	0	0	0	0	1	**0,17**
Sturnidae	*Poeoptera stuhlmanni*	Stuhlmann's starling	N.A.	FF	LC		N.A.			1	1	0	0	0	0	**0,33**
Sylviidae	*Sylvia abyssinica*	African hill babbler	Olariaki	FF	LC		N.A.			0	0	0	0	0	1	**0,17**
Turdidae	*Zoothera piaggiae*	Abyssinian ground trush	Legorgo (Eriepuli)	FF	LC		Decreasing		Forest and bamboo	1	0	0	0	0	0	**0,17**
AVERAGE OF HIGH QUALITY FOREST INDICATORS (FF)										**1,00**	**0,86**	**0,79**	**0,79**	**0,21**	**0,36**	**0,67**
Nectariniidae	*Nectarinia kilimensis*	Bronzy sunbird	Indiptipet/ embibi	*f*	LC		Decreasing			0	0	0	0	0	2	**0,33**
Nectariniidae	*Nectarinia reichenowi*	Golden-winged sunbird	Indiptipet tap moschet/ embibi	*f*	LC		Decreasing			0	0	0	0	0	2	**0,33**
Nectariniidae	*Nectarinia tacazze*	Tacazze sunbird	Indiptipet/ embibi	*f*	LC		Decreasing		Open areas	0	0	0	0	0	2	**0,33**
Ploceidae	*Ploceus baglafecht*	Baglafecht weaver	Pich/oltinyoki	*f*	LC	Crop destruction	Decreasing		Open areas	0	0	0	0	0	2	**0,33**
AVERAGE OF LOW QUALITY FOREST INDICATORS (*f*)										**0,00**	**0,00**	**0,00**	**0,00**	**0,00**	**2,00**	**0,33**

Birds

Regarding the animal distribution, the community from Kiptunga drew polygonal ranges for 20 mammal species (Artiodactyla: n=6; Carnivora: n=5; Hyracoidea: n=2; Primates=3; Rodentia: n=3; Tubulidentata: n=1). Informants (unaware of any ecological distinction) then added the point data regarding 18 bird forest species, later clustered according to the biological indicator used in Koibatek Forest as high-quality (FF) or low-quality (f) forest indicator species (Bennun et al., 1996).

Biodiversity hotspots were identified in a GIS environment as the result of overlays of species ranges, ranging from 2–17 overlapping layers/species/per pixel. The participatory exercise revealed the occurrence of high levels of species overlay in the largest areas of indigenous forest. The final map (Fig. 4.8) illustrates the results, including data from mammals and bird species. While most of the points indicating forest specialist birds (FF) fall in mammals' high overlay areas, points indicating forest generalist birds (f) are typically located on the edge of the forest.

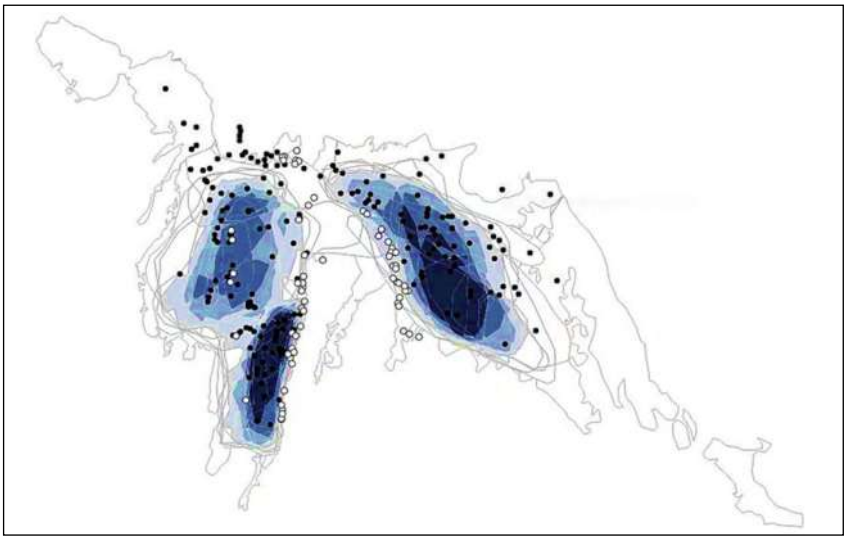

Fig. 4.8 - Overlay of mammals' ranges and birds' spotting sites as identified by the local community in Kiptunga Forest (Trivellini, 2018). Range (light to dark blue), class 1: 1–3 species; class 2: 4–6 species; class 3: 7–9 species; class 4: 10–12 species; class 5: 13–16 species. For birds, black dots represent individuals of species as high-quality forest indicators (FF), and white dots represent individuals of species classified as low-quality forest indicators (f).

As in the case of Koibatek, in Kiptunga the ecological information emerging from participatory data was very consistent between the two investigated wildlife groups (mammals and birds), and the difference between the tree plantations and the indigenous forest areas was shown to be the most important

distinction within the protected area. The issue of the ecological connectivity of forests emerges as central; preserving the remaining corridors and restoring the functionality of other key points will be crucial to the long-term conservation of Mau's ecological system (see chapter 9).

4.3 Ndoinet Forest

The Ndoinet Forest section differs from the other two by the absence of silviculture and PELIS schemes (see sub-chapter 5.2) and the presence of a degraded "transition forest", which is the outcome of a complex history of human occupation and forced evictions (see subchapter 2.3). In this case, the most relevant human activity for the forest is cattle and sheep grazing, evidencing an increasing gradient of forest integrity from east to west.

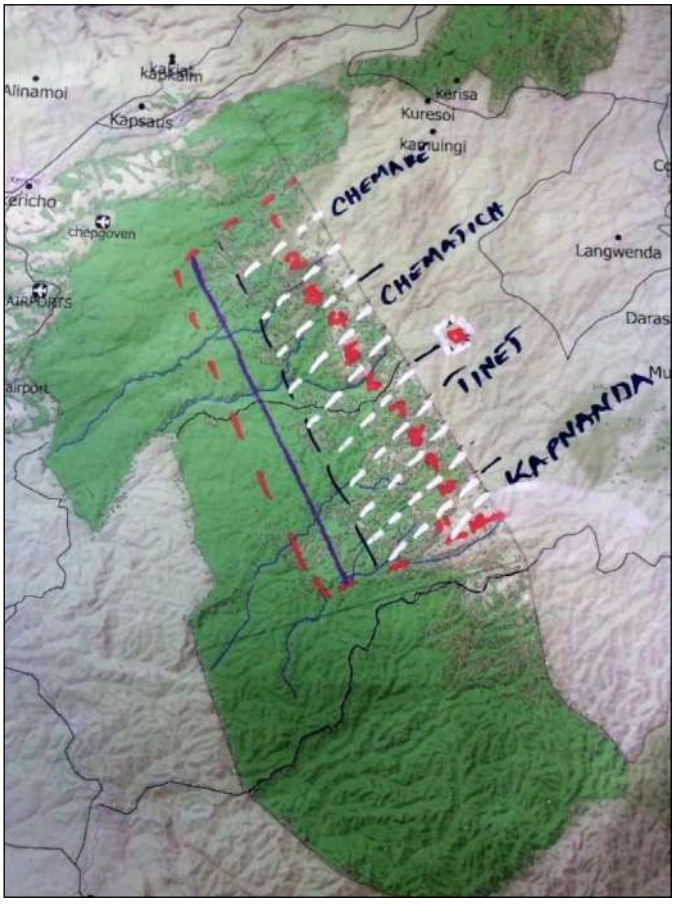

Fig. 4.9 - Ndoinet Forest map modified by the community (Trivellini, 2018). The lines indicate grazing ridges (white) and the indigenous Ndoinet Forest (blue) and its administrative section boundary (red).

To map the presence of animal species within the forest, the community first chose to identify land use patterns connected to grazing activities (Fig. 4.9). Therefore, the study area was divided into two macro-areas—in the western part, an inner zone where indigenous vegetation prevails and in the eastern section, an area closer to the settlements that corresponds to the one that was occupied in the 1990s and 2000s, where grasslands are used for grazing. This second area is functionally divided into 12 sections, following the grazing ridges identified by the community members. As above for Kiptuget Forest and Koibatek Forest, the two forest sections west of the Ndoinet Forest (Itare and Mara Mara forests) but ecologically connected to it are considered a potential source area for biodiversity and are therefore considered in our ecological evaluation.

Mammals

The results of the focus group meeting with the community concerning the presence of mammals in the Ndoinet Forest are presented in Table 4.5 and can be summarized as follows. According to the community's perceptions, of 24 present species, 12 have a decreasing population trend and seven (30%) have an increasing trend[6]. Of the 12 declining species, eight (67%) suffer from both overharvesting and habitat loss, three species (25%) are declining only due to overharvesting, and only one species (the carnivore *Leptailurus serval*) is declining due to habitat loss alone.

Twelve species were shown to have a potential direct use by the community or an economic utility (meat, skin, ivory), which explains the existence of some hunting activity. Of this sample of "useful" species, 92% (11 of 12 species) have a declining population trend, and in this group only the dik-dik (*Madoqua kirkii*) was reported to have an increasing trend, consistent with the fact that the species is generally known to be anthropophilic (Brotherton, 2013). At the same time, 6 of the "non-useful" species (55%) have an increasing population trend. Of the 11 species apparently in conflict with human activities, 6 that are considered "useful" are declining, while 5 species without a specific utility are not perceived as declining.

The depicted situation emphasizes the importance of the variable "utility" in determining population decline, more than what happens, for example, for the variable "human–wildlife conflict". Therefore, hunting activity, particularly small-scale poaching for subsistence food, seems to play a significant role in determining negative population trends.

As for the other forests, the community was asked to state the perceived probability that the investigated species were absent, rare, or common (see detailed methodology at the beginning of the chapter) in the different sectors of

6 Four species characterized by poor information are not considered in the percentage calculation.

Table 4.5 - Mammals present in Ndoinet Forest (Trivellini, 2018)

Classification					Relationship with the community				Detectability Index		
Order	*Species name*	English name	Local Name (Kalenjin)	IUCN	Utility for the community	Human-wildlife conflict	Perceived population trend	Causes of perceived variation	Grazing sections	Indigenous forest sections	Average all sections
Artiodactyla	*Cephalophus harveyi*	Harvey's red duiker	Mindet	LC	Food	N.A.	Decreasing	Hunting, habitat loss	0,00	1,83	0,61
Artiodactyla	*Cephalophus silvicultor*	Yellow-backed duiker	N.A.	NT	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.
Artiodactyla	*Madoqua kirkii*	Dik dik	N.A.	LC	Food	N.A.	Increasing	Hunting	2,00	1,17	1,72
Artiodactyla	*Nesotragus moschatus*	Suni	Kipkiesegiet	LC	Food	N.A.	Decreasing	Hunting, habitat loss	0,00	2,00	0,67
Artiodactyla	*Potamochoerus larvatus*	Bushpig	Toraet	LC	Food	Crop destruction	Decreasing	Hunting, habitat loss	0,00	2,00	0,67
Artiodactyla	*Syncerus caffer*	Buffalo	Soeet	NT	Food	N.A.	Decreasing	Hunting, habitat loss	0,00	0,83	0,28
Artiodactyla	*Tragelaphus eurycerus*	Bongo	Sulguita	NT	Food	N.A.	Decreasing	Hunting	0,00	0,50	0,17
Artiodactyla	*Tragelaphus scriptus*	Bushbuck	Boinet	LC	Food	N.A.	Decreasing	Hunting	1,00	1,83	1,28
Carnivora	*Canis aureus*	Jackal	Lelwot	LC	N.A.	N.A.	Increasing	N.A.	0,67	1,00	0,78
Carnivora	*Crocuta crocuta*	Hyena	Kimagetiet	LC	N.A.	Predation on cattle	Increasing	N.A.	0,00	2,00	0,67
Carnivora	*Leptailurus serval*	Serval	Kesogororet	LC	N.A.	N.A.	Decreasing	Habitat Loss	0,00	1,00	0,33
Carnivora	*Mellivora capensis*	Honey badger	Kokto	LC	N.A.	Beehive destruction	Increasing	N.A.	1,00	1,00	1,00
Carnivora	*Panthera pardus*	Leopard	Cheplanget	VU	N.A.	Predation on cattle	Increasing	N.A.	0,00	1,00	0,33
Hyracoidea	*Dendrohyrax arboreus*	Tree hyrax	N.A.	LC	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.
Primates	*Cercopithecus ascanius*	Red-tailed monkey	Kibirirchok	LC	Skin	Crop destruction	Decreasing	Hunting, habitat loss	1,33	2,00	1,56
Primates	*Cercopithecus mitis*	Blue monkey	Tisiet	LC	Skin	Crop destruction	Decreasing	Hunting, habitat loss	1,67	2,00	1,78
Primates	*Colobus guereza*	Black and white colobus	Koroitiet	LC	Skin	Crop destruction	Decreasing	Hunting, habitat loss	1,67	2,00	1,78
Primates	*Papio anubis*	Olive Baboon	Chereret	LC	N.A.	Crop destruction	N.A.	N.A.	2,00	1,00	1,67
Proboscidea	*Loxodonta africana*	Elephant	Beliot	EN	Ivory	Crop destruction	Decreasing	Hunting, habitat loss	1,17	1,67	1,33
Rodentia	*Anomalurus derbianus*	Flying squirrel	N.A.	LC	N.A.	N.A.	N.A.	N.A.	1,00	2,00	1,33
Rodentia	*Colomys goslingi*	African wading rat	N.A.	LC	N.A.	Crop destruction	Increasing	N.A.	2,00	1,00	1,67
Rodentia	*Heliosciurus rufobrachium*	Red-legged squirrel	Keboet	LC	N.A.	N.A.	Increasing	N.A.	1,00	2,00	1,33
Rodentia	*Hystrix cristata*	Porcupine	Cheswereret	LC	Food	Crop destruction	Decreasing	Hunting	1,00	1,33	1,11
Tubulidentata	*Orycteropus afer*	Aardvark	Chemenghewet	LC	N.A.	N.A.	Increasing	N.A.	1,00	1,00	1,00
Average									0,88	1,47	

the forest station and then to draw a polygonal species range for mammals or spotting points for birds.

This participatory data analysis showed a clear difference between the 12 grazing areas and the inner ungrazed portions of indigenous forest (Ndoinet, plus the deep forest of Itare and Mara Mara). In general, the focus group data on detectability indexes (Fig. 4.10) proved to be very consistent with the species range maps drawn by the community, indicating that the grazing areas degraded by the encroachments of the 1990s and 2000s are marked by the lack of many wildlife species.

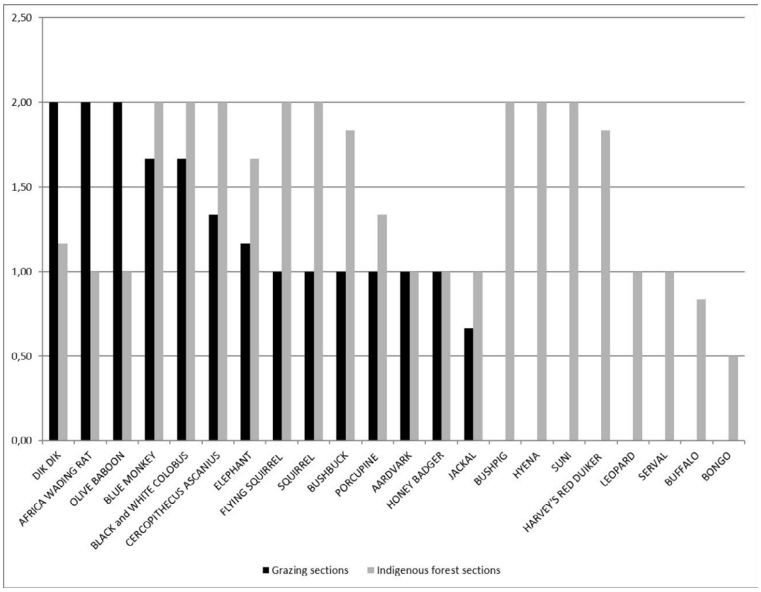

Fig. 4.10 – Mammals' detectability index in Ndoinet Forest (Trivellini, 2018). Data are sorted according to the detectability in grazed areas as an indication of ecological adaptability to anthropized areas.

With reference to Fig. 4.10, it should be noted that almost all animals have Least Concern (LC) as an IUCN category; the only Near Threatened (NT) species are the bongo (*Tragelaphus eurycerus*) and the yellow-backed duiker (*Cephalophus silvicultor*), which have a minimal probability of occurrence. For most species, the community detectability index seemed to be usable as a key to read the species' sensitivity. However, data on the presence of the elephant (*Loxodonta africana*, IUCN CR) does not indicate it is widespread. Due to the total lack of site fidelity and the species' well-documented ability to move across the largest ranges (Ngene et al., 2017, among many), they may also visit areas of secondary quality, but their presence occurs very rarely as part of a complex migratory pattern involving areas larger than the entire southwest forest sector.

The lack of occurrence of some ungulates in the eastern section is representative of their status as typical game species, as they are likely targeted

by poachers. The high probability of the occurrence of the dik-dik (*Madoqua kirki*) is consistent with the fact that this has been described as the only "useful" species with an increasing population, due to its high level of adaptability (Brotherton, 2013). The high average index of detectability of monkeys is related to their effective adaptability to a wide number of habitats, testified by their involvement in agricultural human–wildlife conflicts and by the existing literature (*Cercopithecus mitis*: Butynski, 1990; *Colobus guereza*: Fashing and Oates, 2013; *Cercopithecus Ascanius*: Cords and Sarmiento, 2013; *Papio anubis*: Zinner, 2013).

When considering the division between the grazing sectors (east) and the indigenous forest (deep forest in the Ndoinet western section, plus the Itare and Mara sectors), it is evident that some species are absent in the eastern sectors. The bongo, the yellow-backed duiker (both IUCN NT), the suni, the bushpig, the Harvey's duiker, and the buffalo are ungulates of high hunting interest, while the leopard, the serval, and the hyena are predators of the former, which determines the presence of the latter. In conclusion, while the western part of Ndoinet Forest is a hotspot for different mammals and a refuge for the most hunted ones, due to the absence of anthropogenic disturbances, the eastern part is *de facto* the grazing area of the Southwest sector where many species are no longer present due to greater anthropic pressure.

Birds

Table 4.6 presents the common, scientific, and local names of avian fauna and the results of the data collection. The avian fauna are distinguished according to the already identified two classes of birds, indicators of a higher forest quality (FF) or a lower forest quality (f).

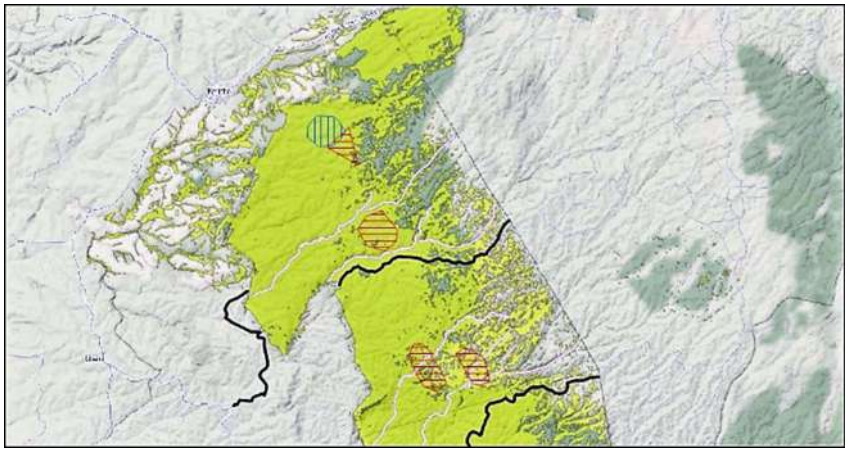

Fig. 4.11 - Yellow-backed duiker (red) and bongo (blue) ranges in Ndoinet Forest (Trivellini, 2018). The selection by these species between the anthropized and not anthropized areas is clearly visible.

Table 4.6 - Birds present in Ndoinet Forest (Trivellini, 2018)

Classification						Perceived Population trend	Detectability index	
Family	Species name	Common name	Local name	IUCN	Forest indicator		Grazing sections	Indigenous forest sections
Accipitridae	*Buteo oreophilus*	Mountain buzzard		NT	FF	Increasing	1,00	1,00
Campephagidae	*Coracina caesia*	Grey cuckooshrike		LC	FF	Decreasing	0,00	1,00
Fringillidae	*Crithagra burtoni*	Thick-billed seedeater	Chemugulgut	LC	FF	Decreasing	1,00	0,17
Nectariniidae	*Anthreptes rectirostris*	Green Sunbird	Chibitchibit	LC	FF	Increasing, very common	2,00	1,00
Nectariniidae	*Nectarinia kilimensis*	Bronzy sunbird	Chesibit	LC	f	Increasing, very common	1,00	0,00
Nectariniidae	*Nectarinia reichenowi*	Golden-winged sunbird	Chesibit	LC	f	Increasing, very common	1,00	0,00
Nectariniidae	*Nectarinia tacazze*	Tacazze sunbird	Chesibit	LC	f	Increasing, very common	1,00	0,00
Picidae	*Campethera tullbergi*	Tullberg's woodpecker	Kongoniet	LC	FF	Decreasing	1,00	2,00
Ploceidae	*Ploceus baglafecht*	Baglafecht weaver	Chepsakiat	LC	f	Increasing, very common	2,00	1,00
Ploceidae	*Ploceus insignis*	Brown-capped weaver		LC	FF	Decreasing	0,00	1,00
Stenostiridae	*Elminia albonotata*	White-tailed crested-flycatcher		LC	FF	Decreasing	0,92	1,00
Strigidae	*Glaucidium tephronotum*	Red-chested owlet	Psugrut	LC	FF	Increasing	1,00	1,00
Sturnidae	*Onychognathus walleri*	Waller's starling	Chepchuba	LC	FF	Increasing	1,00	0,00
Sturnidae	*Poeoptera stuhlmanni*	Stuhlmann's starling		LC	FF	Decreasing	0,00	1,00
HQFI (FF) BIRDS							**0,79**	**0,92**
LQFI (f) BIRDS							**1,25**	**0,25**

From the table, we can see that out of 10 FF species (good forest indicators), 6 are perceived as decreasing by the informants and 3 are perceived as increasing. At the same time, all 4 "f" species (low-quality forest indicators) (100%) are perceived as increasing and very common.

The participatory mapping of birds confirmed the clear distinction between the eastern and the western parts of the forest[7]. Forest specialist bird (FF) data points fall typically in the western area, while data points on low-quality forest birds (f) fall in the eastern edge of the forest (Fig. 4.12).

It is important to emphasize that while deforestation can potentially result in a habitat loss for the first group, it can result in a habitat gain for the second group. It should be noted that while specialist bird species (FF) are still present in the most impacted areas, low-quality forest species (f) were never mapped in the western dense forest. This is consistent with the fact that the ecotonal area where grazing is practiced is produced by the loss of a dense forest and not by the filling of a previously open area.

Birds suffer fragmentation much less than mammals (Lino et al., 2019) and can have a different spatial perception compared to large mammals. Forest

7 While we also considered Itare and Mara as biodiversity sources, the community was working only on Ndoinet Forest and therefore mapping species only up to the western boundaries of Ndoinet Forest (outermost slanting line).

edges still host large patches of indigenous forest (see chapter 3). While the size of these areas is probably sufficient for the presence of some high-quality forest (FF) bird species, it is too small to safely accommodate large wild mammal species that need to hide in the deep forest and that are more sensitive to human presence due to hunting or other anthropogenic disturbances.

Fig. 4.12 - Map of mammal and bird species in Ndoinet Forest (Trivellini, 2018). The polygons indicate the areas where there are bushbuck (light blue), buffalo (red), bongo (blue). Point data indicate the presence of specialist birds (green dots) and generalist birds (white dots).

Part 2
The natures of Mau Forest

The public narrative of the Mau Forest tends to produce an image of homogeneity (the complex is usually cited as a single entity) focused on its natural component, a "primary" forest threatened by deforestation (GoK and UNEP, 2008). On the contrary, the reality is that the Mau complex is characterized by great heterogeneity, and its features, far from being "primigenial", are the outcome of historical interaction with human communities.

To bring order to this heterogeneity, we have identified two categories of variables that define different forms of interaction with the forest. First, the forest has relatively low anthropized areas (where indigenous vegetation prevails) alongside completely artificial ecosystems (e.g., monospecific plantations for commercial forestry). Along with this first typological distinction, we wanted to include a second class of variables that refers specifically to the actors involved. Therefore, we have parts of the forest in which the transformation (or conservation) initiative comes predominantly from local communities and other areas in which the initiative is primarily exogenous (national and international companies and organizations). This dual articulation produces a matrix of four forest types that define different forms of co-evolution between society and nature, identifiable as productive systems connected to a particular nature in the Mau Forest. We have used the term "socio-ecology" to highlight the inseparable link between society and nature that gives rise to relatively stable relationships over time between human and non-human elements (Albertazzi and Bini, 2021).

The first type of socio-ecology is the socio-ecology of forestry, defined by the cultivation and trade of timber grown in monospecific plantations of pine, cypress, and eucalyptus trees. These are completely artificial ecosystems (although they are considered forests according to the Food and Agriculture Organization [FAO] definition; FAO, 2020) in which land transformation is driven by exogenous actors, particularly national companies such as Timsales. Tree plantations are developed within the boundaries of the protected area on state-owned lands administered by the KFS. In the research area, silviculture is particularly developed in the sections of Koibatek (Mt. Londiani sector) and Kiptunga (East Mau sector). Today, it is a socio-ecology in crisis, due to the imposition in 2018 of a government ban on logging in state-owned forests.

The second type of socio-ecology, family farming in settlement schemes, refers to an agro-pastoral production system in which agriculture and livestock activities are practiced almost exclusively for subsistence purposes. These systems exert considerable pressure on the forest, and the outcome is, like in the previous case, a sort of man-made forest, although here the main actors are the local communities. This production system can be found in the villages adjacent to the

forest whose presence was formalized and legitimized in the Moi government's settlement plan (1993–2001). Family farming generally focuses on maize production and animal rearing on farms of about 2 ha in size. An important element is livestock grazing within the protected area, particularly in open forest spaces, such as in the Ndoinet section where grasslands are used as common use space.

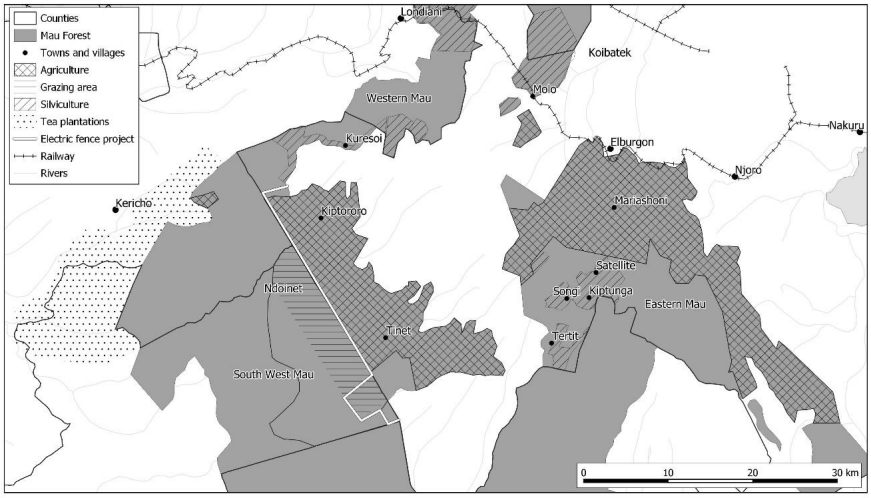

Fig. II.1 - Distribution of the four socio-ecologies in the research area (Albertazzi and Bini, 2021)

The third type of socio-ecology we identified is that of conservation, which is characterized by little anthropization and a strong exogenous presence. Particularly prominent here are the multinational tea companies Finlays Kenya and Unilever Kenya, which practice large-scale, export-oriented agriculture in Kericho County. In Kenya, tea (*Camellia sinensis*) production areas are located adjacent to upland forests because these environments provide ideal conditions for plant growth (humidity and climate regulation, rainfall; GoK and UNEP, 2008). This production system is particularly dependent on the ecosystem services provided by the forest. For this reason, multinational tea corporations are funding a conservation project that is highly restrictive of forest use (ISLA-IDH, 2018) and that aims to produce an intact and "wild" forest where no signs of human presence are found.

The last type of socio-ecology we analyzed is a sort of renewed indigenous agro-forestry system that is based on honey production and sustainable tourism activities. This can be particularly found in the eastern forest sector of Mau (Kiptunga section), where there are some Ogiek villages, the only ones allowed within the boundary of the entire Mau Forest. This socio-ecology is not characterized by a purely functional relationship with the forest, as in the case of family farming; it is an integration of the natural and cultural components that simultaneously ensures the existence of Ogiek society and the protection of the forest.

5 Silviculture

The FAO definition of forest does not make a distinction between natural and planted forest (FAO, 2020), but tree plantations are a special form of relationship between society and nature and therefore deserve a separate analysis. In the case of the Mau Forest, the bond with silviculture is profound, both in quantitative terms and in relation to the historical role played by this activity in the area. Monospecific plantations are widespread in the forest, especially in the central and northern part. In the Koibatek and Kiptunga sections, for example, silviculture occupies about one-third (3,000 ha out of 9,000) and one-fifth (2,000 ha out of 10,300 ha) of the forest, respectively. In these areas, tree plantations occupy state-owned lands and are administered by the KFS or given in concession to private companies, such as Timsales. Historically, the classification of the area as "forest reserve" is directly connected to the need by the colonial administration to preserve wood as an economic good and to develop a profitable activity of silviculture. It is therefore necessary to briefly retrace the colonial strategy to understand the evolution of this part of the forest.

5.1 History

The story of the Mau Forest is indissociable from the presence of the Mombasa–Kisumu railway, "the origin and spine of what we now call Kenya" (Wainaina, 2011, p. 40). Not only was Mau's timber extensively used in constructing the railroad and to meet its energy needs, but the very economic development of silviculture activity is strictly connected to this crucial infrastructure that still marks the landscape of this area (Ofcansky, 1984).

In the first decades of the 20th century, plantations of exotic trees started to replace the natural vegetation cover[1]. The planting of fast-growing species was due to the desire to hinder the pressure exerted on the forest by agriculture, to respond to the demand for raw materials, and to encourage the development of a market for such products. In this context, forestry grew rapidly in the first phase, with the development of many small sawmills in the Mau area. During the Great Depression, the sector experienced a moment of crisis with the failure of some companies but later evolved into a more stable organization that was consolidated by the independent state. In this sector, therefore, there is a remarkable continuity between the colonial period and the post-colonial period. During the European occupation, all the material and symbolic elements that still characterize this form of land organization were fixed.

1 District Forest Office of Elburgon (n.d.), available at the Kiptunga Forest station.

From a material point of view, the main transformation brought about by colonial forestry concerns the territorial order imposed on the forest. In fact, it was in this phase that the "forest reserves" were demarcated, and their boundaries have remained substantially unchanged up to now, limiting the usage rights of the indigenous communities. From an environmental point of view, the colonizers replaced the complex nature of the primary forest with monospecific plantations and started a form of "scientific" management of the territory made up of measurements and mapping built on an orthogonal plot that is almost the symbol of colonization itself.

The colonial origin is also evident in the organization of the actors involved in forestry. First of all, in this phase emerges the close relationship between the state, owner of the forest lands, and private companies. Timsales, the main company operating in the sector in Kenya, was established in 1932 with the merger of seven sawmills created a few years earlier and obtained the management of large portions of the forest[2]. With decolonization, control of the company was taken over by local management, but the strong link with the political system remains (particularly the Kenyatta and Moi families; Ndii, 2018). Several agreements repeatedly entrusted the private company with the management of large portions of the forest reserve. Timsales progressively became a crucial economic actor in the region, at the same time shaping the landscape of the forest through its plantations, and outside the protected area, contributing to the development of the city of Elburgon, where Timsales is headquartered and which became a sort of company town that now has a population of approximately 30,000 (KNBS, 2019).

The second arrangement that originated in the colonial era and that still exists, albeit in slightly different forms, is the intersection between forestry activities and family agriculture. This occurred in the *shamba* system, in which farmers can cultivate the fields in which the trees intended for forestry have been planted for a few years. This technique, quite widespread within the British Empire, was first adopted in Kenya in 1910 (Fanstone, 2020) and has been revived today under PELIS (see below).

The last area of attention concerns the symbolic dimension. Although the terms have changed somewhat and the word "sustainable", for example, has been used in its current meaning only since the 1980s, there is substantial continuity in the ways in which forestry is described—essentially in terms of a rational organization of the land that allows its use in the long term and opposes the "irrational" uses of local populations and immigrant farmers. In colonial Kenya, in fact, alongside the common conflict between the colonizers and the local population, there was a tension between the foresters who aimed at the valorization of the forests through scientific forestry and the settlers who

2 https://timsales.webflow.io/about

wanted to rapidly exploit the forest's timber or simply convert these areas into agricultural land.

The conflict between the timber industry and the Forest Department is well represented by the case of the Lembus section in the central part of the Mau Forest. This 26,000-ha forest has crucial environmental value for the Rift Valley region because it hosts the source of the Perkerra river, one of the most important waterways in the region. The area was acquired by the English businessman Ewart Grogan in 1904 with the purpose of developing the timber industry through his Equator Sawmills company. The tension with the Forest Department lasted for decades until the company ceased its operations in 1935 due to the consequences of the international economic crisis, and the area returned to the control of the Forest Department (Anderson, 2002).

5.2 The nature of silviculture

Generally, in the Mau Forest silviculture occupies areas with moderate slopes (less than 30%), the most suitable for the mechanical operations that characterize this activity. In the Koibatek section, which covers the southern versant of Mount Londiani, it means that the plantations are concentrated in the lowest part of the forest. In the case of Kiptunga, which occupies the ridge between different watersheds, silviculture alternates with natural forests.

The nature of this socio-ecology consists of allochthonous species of cypress (*Cupressus lusitanica*), pine (*Pinus patula, Pinus radiata*), and some varieties of eucalyptus (e.g., *Eucalyptus Saligna*). These are fast-growing species whose timber can be used 10–15 years after planting for the pole and energy production varieties (mostly eucalyptus) or after 25–30 years for varieties used for processing by the timber industry (cypress and pine) (KFS, 2014).

The organization and the planting time define the characteristics of these forests and shape the landscape. First, trees are placed linearly and close together, averaging 500–1500 per acre of land, an arrangement that serves to maximize yield and available space. Second, during its growth the plantation is subjected to cyclical and planned operations of pruning and thinning. The first term means the removal of branches, which is necessary to allow the plant to develop without impediments by enlarging the trunk in height and width. The second term identifies the progressive removal of trees to allow the remaining ones to increase their biomass. This means that of the initial amount of plants present, one-sixth will remain[3]. Tree plantations are organized and managed in a rather strict way through 10-year plans and detailed mapping. In some cases, they are controlled and monitored to prevent the theft of timber[4].

3 Personal communication, KFS forest manager (2022).

4 Personal communication, KFS ranger (2022).

The presence of tree plantations creates a soil poor in fertile substances, with an almost non-existent undergrowth and equally poor biodiversity. Research has shown that the only animal species found on tree plantations are anthropophilic (cattle, sheep, hyenas). For this reason, planted forests are called "silent forests" due to the absence of noise that differentiates them from natural forests (Maathai, 2011; Trivellini and Lindon, 2014).

The peculiar ecosystem that characterizes these monospecific forests is complemented by the nature produced by PELIS (Fig. 5.1). In the framework of this program, the farmers cultivate the plots, generally about half an acre in size, cleared by forestry activities, during a period of 4 years until the canopy of the new trees hinders the proper development of the crops. Koibatek and Kiptunga PELIS areas mostly host monocultures of maize and potatoes, and agriculture is conducted in a conventional way with the systematic use of chemical inputs. Among the chemicals used are fertilizers (e.g., Cropsta multipurpose, a typical NPK foliar fertilizer), insecticides (e.g., Atom and Oshotion, both manufactured in India and based on deltamethrin and malathion, respectively), fungicides (e.g., Zetanil, manufactured in Italy and based on Mancozeb and Cymoxanil), and herbicides (e.g., Moto Plus, manufactured in China and based on Metribuzin).

Fig. 5.1 - Agriculture in a PELIS area, Koibatek Forest (source: Valerio Bini, 2022)

On the whole, therefore, the PELIS program produces a heavily anthropized environment that contributes to the fragmentation of the forest ecosystem. Silviculture segments the forest in a direct way because plantations are access-controlled areas but also in an indirect way because they are low-complexity environments in which the ecosystem services (MA, 2005) are significantly less than in the indigenous forests where people practice beekeeping, collect medicinal herbs, and perform rituals. Ecologically, plantations are also spaces in which the complexity and relationships of living organisms are kept to a minimum. They are controlled and managed by the company to make resources economically efficient, thus promoting rapid growth and maximum biomass volume.

It has been highlighted that plantations are the outcome of a reorganization of the living world in which organisms are dissociated from their original ecologies and are reproduced in identical forms to maximize replication speed and efficiency (Tsing, 2015; 2018). On the Mau Forest plantations, two processes typical of this spatial form are found. First, identical single-species organisms (eucalyptus, pines, cypress) are assembled together in a bounded space. Second, these organisms are alien and isolated from the surrounding ecologies, thus producing a fragmentation in the ecology of the indigenous forest.

5.3 The narrative of sustainable forestry

As pointed out earlier, the narrative of silviculture as the rational way to manage a forest has played a crucial role in the development of this activity in the Mau Forest since colonial times. Bryant (1996) has shown how colonial forestry services used the narrative of "progress" to introduce forms of forest management that tried to preserve the economic value of the forest in a "scientific" way that today we would call "sustainable".

Over the decades, many different narratives have accompanied the evolution of forestry on a global scale. Singer (2015) identifies five successive cycles of ideologies that guided tropical forest management—ecological conservation, participatory management, good governance, sustainable management, and the forest–climate nexus (particularly through the REDD+ program[5]). The contemporary narrative of silviculture within the Mau Forest makes particular reference to the last two principles and thus invokes the idea of the economic exploitation of forest resources that can last over time and emphasizes the role that planted forests play in absorbing carbon dioxide.

5 REDD+ stands for Reducing Emissions from Deforestation and Forest Degradation. Through REDD+ initiatives, financial incentives are provided to developing countries to protect, manage, and responsibly use their forest resources with the aim of combating climate change.

On the Timsales website, the environmental dimension is addressed in a specific section in which the company's role in the fight against deforestation is emphasized:

> The vigorous re-afforestation program supported by Timsales Limited will ensure that the forest has a continued existence for many years to come. The depleted forest areas are now replenished on a sustained basis. The firm's re-afforestation rate is much higher than the rate of deforestation, aiding in achieving the firm's objectives in conservation[6].

This narrative is based on a specific idea of nature strongly connected to the scientific paradigm of ecosystem services within which ecosystems are analyzed in a segmented way, identifying the single functions performed with respect to human societies, with particular reference to the carbon cycle and the regulation of the hydrological regime.

In the climatic context, the forest is essentially narrated as a "carbon sink", and in this sense forestry responds to the need to increase the forest area of the planet, regardless of the qualitative characteristics of the forest itself. Regarding the regulation of the water cycle, this is a central issue for a state with serious problems of access to water resources, such as Kenya. The country framed the defense of forests essentially as a tool for the protection of the strategic watersheds (the forests considered as "water towers"). In this direction, the Kenyan government has created the KWTA, the government agency entrusted with the management of the country's upland forests.

In these perspectives based on the reduction of forests to mere providers of specific ecosystem services, there is an equalization between planted and natural forests and therefore a sort of "fungibility" between the two environments. At the international level, this equivalence is rooted in the FAO approach that considers monospecific tree plantations as part of reforestation programs (FAO, 2020).

On the national scale, we find the same idea of equivalence between indigenous forests and plantations. In the mapping of East Mau produced by the KWTA (2019, p. 28), for example, there are no differences in the representations of the various forest covers (forest, open forest, grassland), although they perform very different functions from a social and environmental perspective. The same is true in the KFS's multi-year strategic plan (KFS, 2017, p. 15) where the first goal listed is the rehabilitation of the country's five main forests, including Mau, and among the various strategies is listed planting with exotic species.

The "discourse" of forestry is thus centered on the combination of sustainability and ecosystem services that drives many national and international policies and frames the forest essentially in terms of its economic value, thus

6 https://timsales.webflow.io/about

equating naturally growing forests and artificial ecosystems, such as monospecific plantations.

5.4 Silviculture: what future for monofunctional forests?

Silviculture in the Mau Forest is more than just a way of managing forests; its history is intertwined with the evolution of this area to such an extent that in some portions of the Eastern sector one has the feeling of being in a "company forest". Timsales company controls large portions of the forest, its factory shapes the landscape of the town of Elburgon, and for decades it has provided work for the majority of wage laborers in the area. As is often the case in such situations, its role has extended far beyond the economic sphere, investing in society as a whole through the construction of "Timsales schools" and even the creation of the local soccer team (Timsales F.C.).

Fig. 5.2 - Planted forest managed by Timsales in Kiptunga (source: Stefania Albertazzi, 2022)

The artificial forest that is the outcome of this now centuries-old activity is a monofunctional space, simplified in its material and discursive characteristics and extremely fragile because its structure is monostable and thus exposed to the fluctuations of the markets on which it depends. This aspect is crucial to understand the present situation of this part of the forest. In 2018, the government imposed a logging ban in public and community forests triggering a

structural crisis that still persists. The ban, officially motivated by a desire to protect tree cover, was partially lifted in 2020 but still directly affects the activity of the forest sections that are more linked to silviculture, such as Koibatek and Kiptunga. The action also appears to be linked to a need for government intervention in the commercial timber sector to address mismanagement brought to light by a KFS investigation (Ministry of Environment and Forestry, 2018).

The consequence of this stop to logging activities produced effects in at least four ways. First, many forest sections depend financially on the benefits coming from forestry timber sales. In Koibatek Forest station, for instance, in the period 2009–2012 the benefits deriving from timber (160 million KES for the 4 years) covered 98% of the total income from forest activities. Second, at the moment the plantations lie in a state of semi-abandonment, as no maintenance can be carried out. These activities used to involve the members of the CFAs[7] that consequently have lost economic opportunities and thus bear the brunt of this decision. Third, the ban jeopardized the PELIS program, progressively reducing the areas available for farming. The KFS had set aside spare areas within the plantations that allowed the program to function in recent years, but the process now seems to have reached its limits[8]. Finally, the town of Elburgon was directly affected by the stop of logging activities with thousands of layoffs and the paralysis of the city's economic activities.

The future of this part of the forest is thus strictly connected to the evolution of silviculture, which is at the moment still uncertain. What is at stake now is not only the plantation areas in the forest but the whole socio-environmental structure produced by the silvicultural system.

7 The Community Forest Associations (see sub-chapter 7.2) are village-based organizations composed of local members who gather spontaneously to co-manage a state or a community forest with the Kenya Forest Service.

8 Personal communication, KFS forest manager (2022).

6 Settlement schemes and the forest as commons

6.1 The new geography of settlement schemes

In the 1990s, at the time of the establishment of government settlement schemes within the boundary of Southwest and East Mau, the areas were covered by various natural forests, grasslands, shrubs, and plantation forests (in East Mau). The Ogiek population and other forest-dweller communities were living off shifting agriculture and animal rearing, accompanied in the case of the Ogiek by wild fruit collection, hunting, and beekeeping.

The settlement schemes established across 60,000 ha of Mau Forest have led to a fundamental shift in the geographies of Mau. In particular, in Southwest Mau thousands of people migrated from Kalenjin districts of the Rift Valley Province, while in the case of East Mau the people settled in a formerly low-populated area surrounded by small towns and infrastructure (roads, railway).

The creation of settlement schemes brought forest lands under the control and rule of the government, with the construction of formal villages, under an administrative order, defined through territorial units and constituencies. Specifically, in the case of Southwest Mau the creation of settlement schemes was not connected to the provision of public service (dispensaries, schools, roads); rather, they were initiated by community members and later supported by or included within the state administration, even if in the most remote places they are still lacking today[1]. We can say that there occurred a process of state making (Scott, 1998) that put previously unmanaged and partially uncontrolled forestlands under the jurisdiction of the state.

However, three movements of people occurred that had an impact on forest cover and that had significant social relevance. The first relevant movement was the eviction of forest dwellers prior to the beginning of the settlement program and the gathering of the displaced people near the forest stations that at that time served as waiting points for the registration of the land allocation to future beneficiaries (Southwest Mau). This process led to the abandonment of the informal villages dispersed within the forest boundary, leaving traces of settlement and open forest areas surrounded by functional tree species (e.g., cypress; sodom apple, *Calotropis procera*). The second relevant movement was the spontaneous but politically mediated migration of thousands of people from the Rift Valley Province to Southwest Mau and East Mau that led to a process of

1 Interviews, 2019.

continued and uncontrolled land allocation. This dynamic created the premise for the institutionalized settlement of individuals beyond the designated area of settlement schemes for a certain time and subsequently drove vegetation cover changes inside the natural protected area (Southwest Mau). The third relevant movement was the definitive sedentarization of forest dwellers, particularly the Ogiek, who came to be farmers and ended up living permanently on farmlands. They claim that the forced sedentarization caused sickness in people and livestock, causing a sharp increase in deaths and a difficult adjustment to the environment (different from the forest) for both humans and non-humans[2].

From another point of view, the allocation of public forest lands has generated longstanding hostilities between communities and toward the state that are still relevant today and make Mau Forest much politicized. Intra-community hostility can be traced back to the migration of people to the Nakuru district from neighboring areas that induced a feeling of land dispossession, particularly for the East Mau Ogiek community, who accused other ethnic groups (Kipsigis, Tugen, Maasai) of appropriating what belongs to them by right (an informal right derived by an occupation of several centuries). The relationship with the state is marked by animosity and suspiciousness for different reasons. On one hand, some Ogiek individuals think the government has favored specific tribes with whom there are privileged and stronger patronage ties. On the other hand, there is a general resentment towards certain figures (surveyors, administration officers, politicians) who are considered corrupt and who are held responsible for the allocation to second and third parties of the same parcel of land[3]. Finally, there is a certain sense of abandonment due to the continued presence of the caveat on land transactions, which forces thousands of people into a situation of vulnerability and exposes them to possible eviction[4].

A final element to focus attention on is that the creation of 60,000 ha of settlement schemes with the establishment of permanent populations surrounding the most important water tower of the country put unprecedented environmental pressure on the forest. In fact, 170,000 individuals or 37,000 households (according to the last census; see KNBS, 2019) pose a major challenge to the

2 Interviews, 2022. There are different views on the sedentarization of the Ogiek in settlement schemes. While some members blame the government for the severe impact it had on humans and animals, others remember that period with gratitude and as an important time that laid the foundations for the hoped-for economic development of Ogiek communities.

3 A serious land management issue in Mau's settlement schemes concerns the fact that often a land allocation document reported two or three different individuals as beneficiaries. In other cases, some found that the land they lived on was owned by others and sold by them to third parties without their knowledge.

4 On the matter of eviction organized and threatened by the Kenya Forest Service, a person in Kiptunga (2022) stated that "They cannot evict us, because we were here before them". The sentence remarks the claim of the Ogiek communities of a centuries-long land occupation of Mau.

relationship between society and the forest. Of the various topics involved in this matter (agriculture, infrastructure, social services, etc.), the most pertinent for this research are the issues of energy supply and grazing that allow us to see the dynamics that characterized the ecology of settlement schemes and that produced a specific nature in the Mau Forest.

Fig. 6.1 - Tea buffer zone (left) and farms close to the Ndoinet boundary (source: Drone Adventures, 2019)

6.2 Settlement schemes' metabolism

The rural areas of Kenya are strictly dependent on biomass for their energy needs. Data shows that 90% of people utilize firewood or charcoal for cooking and heating (in the rainy season), while at the national scale the average falls to 70% (UNEP, 2009). The latest 2019 census (KNBS, 2019b) for the Kuresoi South and Kuresoi North areas confirms the figures and attests the use of firewood as cooking fuel by 86% of the population in the two sub-counties, along with the use of charcoal (11%).

The settlement scheme areas are no exception, and households rely largely on firewood from the forest. For lighting, use of the electricity grid or photovoltaic micro-installations is growing, but for cooking and heating the burning of biomass remains almost the exclusive source of energy supply (KFS, 2015; KFS, 2018). Interviews show that all the members of local communities close

to the Ndoinet Forest section (Southwest Mau) (n=105[5]) use firewood as their primary energy source. Of them, it was found that 52% (n=55/105) were exclusively sourcing firewood within the boundaries of the protected area (the major sector of Southwest Mau and the small forest of 32 ha surrounding the Ndoinet Forest station[6]) with varying frequency, depending on the cooking technologies used.

The common cooking system is a high-energy one. It consists of three stones positioned close together, on top of which are placed the pots used for cooking. Evaluation research conducted for a project funded by the Italian Agency for Development Cooperation (Njoroge, 2020) shows that households (with an average of seven members) using the traditional three-stone method consume about 60 kg of firewood per week, corresponding to four trips into the forest with loads of about 15 kg. Multiplied by the number of families living in the protected area, this figure corresponds to approximately 115,000 tons of firewood consumed per year. It is a critical figure, also taking into account the impact on the lives of women, who are mainly responsible for transporting firewood. The activity of searching for and accumulating firewood generally lasts one hour, takes place in the open areas within 1 km of the forest reserve boundary (47% respondents, n=7/15), and is strenuous.

An alternative biomass source of energy is charcoal (for 25%–30% of households; see Njoroge, 2020 and County Government of Nakuru, 2018), the consumption of which is estimated at 15 kg/week per household at a cost of approximately 300 KES (2.3 €). Charcoal is purchased or self-produced locally, either legally from plantation wood or illegally within the forest from more valuable wood (e.g., cedar, podocarpus).

The general rule for firewood collection imposed by the KFS and advocated by the CFA itself is the prohibition of cutting live trees and damaging the forest. Furthermore, each individual is obliged to pay a small fee to get collection permission from the KFS (100 KES or 0.8 €/month). Therefore, open forest areas play a crucial role in the local communities' social metabolism, providing an essential contribution to household energy needs. In this sense, if we

5 Using semi-structured interviews, we investigated the relationship between the Ndoinet Forest and the local communities in the sub-locations of Chemare, Chematich, Tinet, Kapnanda, and Ararwet (Nakuru County) during the period 2018–2020. We met 105 people with the aim of researching a multiplicity of aspects—the socio-territorial context; the process of settlement on the plot; and the uses of the forest by the communities (grazing, wood collection, beekeeping, collection of medicinal products, rituals). The interviewees were mostly members of the CFA of Ndoinet, and in carrying out the work we were assisted by a local collaborator and accompanied by one or two local members who organized the interviews in the villages according to the criteria we requested.

6 The Southwest Mau consists of a main body of 60,000 ha (in which the Ndoinet section is located) and a small forest of 32 ha located around the Ndoinet Forest station and 5 km away from the main forest sector.

visualize the energy relationship between forest and settlement schemes, we would see a unidirectional flow of matter from the former to the latter, reflecting a rigid spatial division between forest and cultivated fields, which in turn echoes the division between nature and society.

However, to facilitate the energy supply and alleviate human pressure on the forest, NGOs are supporting the establishment of private woodlots in the village, distributing fast-growing species (pine, eucalyptus, and cypress) usually planted along the boundary of the farm. The initiative meets a legislative obligation of (RoK, 2009) that imposes a minimum of 10 percent forest cover on private plots, in order to support agroforestry and energy self-sustenance. In 7–10 years, a family will be able to harvest the first tree branch, thereby lessening the supply from the protected forest.

6.3 Grazing and grassland

A similar dynamic is detectable for access to pastures within the boundary of Mau Forest. In this region, the agro–pastoral system predominates, and livestock (cows and sheep) enjoy considerable importance. The farms located adjacent to the natural protected area in the settlement schemes' zone have a limited extension (2 ha) almost entirely devoted to agriculture (maize, sorghum, vegetables). In these units, it is difficult to reserve a space for grazing or producing fodder, and stable farming can be found only in pilot projects funded by international cooperation[7]. For this reason, having grazing areas available is essential for the farmers/herders of the Mau region.

Grazing within the forest is allowed during the day upon a fee payment (100 KES/cow/month), but overnight stays are not permitted. Of the livestock present, sheep are raised for selling or local slaughter (a sheep can be valued at 4,000 KES–6,000 KES or 30 €–45 €), often on special occasions (e.g., Christmas, weddings). Cattle are a key source of livelihood for families and an element of significant cultural importance to the Kalenjin people. Cows are used for milk production and for the safekeeping of wealth and are to be sold only if necessary (e.g., payment of school fees)[8]. The cows owned by the people interviewed are mostly indigenous or hybrid breeds (crosses of local and non-local species) and therefore produce small quantities of milk, about 1 L–3 L per day[9]. Despite the limited amount, only 40.5% (n=17/42) of the respondents produce milk exclusively for family needs, while 59.5% (n=25/42) manage

7 We visited six farms involved in the stable grazing project of SNV NGO, part of the ISLA-IDH partnership.

8 A cow can be worth 15,000 KES–30,000 KES (115 €–235 €), and often a family sells one per year for the reasons mentioned above (74% respondents in our investigation, n=14/19).

9 This is in contrast to cows of the Jersey or Friesian variety that produce 7 L–15 L/day, depending on the quality and quantity of their feed.

to sell half or all the production. Both these values highlight how fundamental milk is for subsistence and for a small market economy in areas marked by high self-consumption.

The product is either sold locally (e.g., to neighbors or commercial centers) or to processing companies (e.g., Coorta, Brookside Dairy Ltd, the latter owned by the Kenyatta family) that collect the milk themselves or to whom the milk is delivered by motorbike taxi drivers (*boda boda*). Prices vary, and there is a general decrease from 30 KES/L to 22 (even 15) KES/L.

More than half of our respondents use the Ndoinet Forest (Southwest Mau) for grazing and access to pastures (54%, n=57/105). As previously mentioned, the first few kilometers from the forest reserve limit (and particularly the areas close to the boundary) into the interior are characterized by the presence of grasslands, the most suitable spaces for grazing. It is worth underlining that it is the history of human occupation and abandonment of the forest reserve, expressed in forward and backward movements of the population, that has created these open areas. Through the actions of cutting down trees and digging soil to establish homes and small farms, which led to the formation of informal small centers, and the grazing of animals and the trampling of the ground, these grasslands have been formed and maintained in the Ndoinet Forest section (Southwest Mau).

Fig. 6.2 - Livestock fence in "Ndoinet transition" Forest (source: Valerio Bini, 2018)

In addition, we can say that the farmers living adjacent to the Mau Forest consider its pastures a sort of farm extension into the natural protected area. First, following informal rules and the geo-morphological shape of the highlands, the farmers of a village usually cross the natural protected area boundary and access the pastures of the same ridge, which is renamed according to the village located in the adjacent settlement schemes. The division into ridges is a system of territorial organization probably derived from the Ogiek culture in which the *konoito* is a strip of land of a few kilometers delimited by streams, over which the lineage had certain rights to use resources, particularly for beekeeping (Blackburn, 1970; 1982).

Second, the forest open areas in which the livestock graze are still identified by the names of the informal villages established in previous decades (see, e.g., the areas of Kapkiwaron, Kimesto, Kipkosor, Cheptalukiat, Kiptegelde, Kipsengwet, and Tilolwet cited in the archival documents of the 1990s as eviction centers that are still present in the cartography of Ndoinet forest[10]). In this sense, the toponymy of pastures is a valuable indicator for tracing the environmental history of the forest. All these elements together emphasize the agency and the role of farmers/herders and their livestock in the production of the forest's nature in general.

The presence of pastures is so important that their availability is probably regulated through fire, an illegal but frequent activity. The extension of the phenomenon is limited and seems not to represent a danger for the forest. A remote sensing analysis for the period 2010–2019 in the Ndoinet Forest section shows that this practice has been intensifying in the last years, with 135 ha of burnt land in 2017 and 550 ha in 2019. The location of the signs of fire varies spatially. They are mostly located near the cutline, between 1 km and 3.5 km, and between 7 km and 9 km, distances that could respectively indicate the grassland used for daily grazing and for the illegal overnight stay of livestock (Fig. 6.2)[11]. It is worth noting that over the years, some of the burnt areas overlap, particularly in the central-southern section of the Ndoinet Forest. This, together with the fact that the areas are generally located close to each other, seems further confirmation that they are not random fires. Instead, fire is probably used to renew the grass or burn the ferns (*Pteris aquilina*) that suffocate and prevent the generation of plants and that can be poisonous to people and animals (KFS, 2019; personal communications, 2019).

Another aspect involved in this relationship with the forest concerns encroachment beyond the protected area's boundary. Although the physical separation between forest and settlements is today more recognizable and respected than in the past, in some locations in the East Mau (Mariashoni and Sigoin

10 See the cartography available at the Ndoinet Forest station.

11 The figures are consistent with what emerged in some interviews in 2019 and 2020.

villages), farms press on the protected area and erode land to turn it into cultivated fields. This process is facilitated by the fact that the vegetation immediately close to the boundary of the protected area is often characterized by a grassland cover or a mix of shrubs, isolated trees, and re-growing species, precisely because these areas are more subject to anthropogenic pressure and harvesting. The response of the KFS is often eviction and a rapid planting of fast-growing exotic species (pines, cypresses) to re-appropriate the area and prevent future encroachment. The reasons behind the encroachment into the forest reserve's boundary are varied. In some cases, these actions are part of an intricate past of previous occupations with respect to which there is a perceived continuing claim. In other cases, they are the work of new immigrants to the area, whose illegal behavior is condemned by other community members[12].

It is important to focus on the fact that this relationship between forest and settlement schemes is specifically centered on open forest areas where people can find firewood and grass within 2 km–3 km from the boundary. The local people approach the dense forest in Ndoinet (Southwest Mau) with tall trees and closed canopy with caution. Slightly less than half of the respondents in our investigation (47%, n=26/55) visited dense forest areas in the last year, mainly to collect medicinal herbs[13]. During the interviews, it emerged that the dense forest is a frightening place because of the presence of wildlife, which is reason enough not to visit it. Several respondents reported that they had not walked into a dense forest for many years, thus showing how the relationship with the forest has changed with the implementation of the settlement schemes.

12 Personal communications in 2020.

13 The fact that the recurring motivation for visiting the dense forest is to collect medical products may suggest that there is a high biodiversity within this canopy that is not found elsewhere (chapter 4). However, several respondents state that they are planting some herbs on their farm, especially those that grow further away from the forest boundary, to have them available at all times.

7 Forest conservation

Forest conservation defines a particular relationship between nature and society that produces a specific geographical configuration. We identified three modalities of conservation with recognizable characteristics that produce different socio-ecological relations—fortress conservation, community conservation, and conservation with direct political purposes.

7.1 Fortress conservation and plantation agriculture

The first kind of nature conservation emerging in the Mau Forest focuses on the link between plantation agriculture (tea) and dense forest. It is strictly connected to the logic, interventions, and narratives developed in colonial times.

The tea plant (*Camellia sinensis*) was introduced from India and established in Kenya at the beginning of the 1900s, while its trade began two decades later (KHRC, 2008). In the 1920s, some British companies established their plantations in the city of Kericho, close to the Southwest Mau Forest, where the presence of Finlays' and Unilever's plantations (over 20,000 ha of land) still mark the landscape. Over the last years, Kenya has always been the world's leading exporter of this product (Intergovernmental Group on Tea, 2022), but recently companies have started to raise the alarm about a production decrease linked to climate change in the area, referring particularly to precipitation volatility (University of Cambridge, 2012; ISLA-IDH and Finlays Kenya Ltd., 2019). The main cause of these environmental changes is found in the deforestation that has characterized the area, and subsequently the solution of conservation emerged as a priority. From this perspective, population and its activities (grazing, firewood collection, charcoal production) are considered the major threats to the forest, and interventions have been put in place to reduce, at minimum, the use of forest by local communities[1]. While in the literature a common pattern of deforestation relates to conversion from forest to plantations (e.g., in South America; see Hosonuma et al., 2012), in this case the large-scale tea estates are driving a specific form of forest conservation[2].

The historical background

"Fortress conservation" has a long history in the Mau region. Its roots can be found in the forest management strategies of colonial times, when the Forest

1 Communication of the Forest Manager of Ndoinet Forest (Southwest Mau) (2019).

2 Tea plantations are not the only kind of cultivation present here; small-scale tea growers have spread, but financial support and planning for conservation can only be traced to multinational companies.

Department governed protected forests for timber production and watershed protection, strictly restricting use by local populations (Mwangi, 1998). This approach to nature conservation is characterized by a top–down perspective based on surveillance and enforcement that denies or severely restricts local communities' access to the forest. The "fortress" reference underlines the defensive and exclusive logic aimed at the protection of a hypothetical "wilderness" that can only be preserved by separating the forest from humans (Adams, 2004).

Decades later, in post-colonial Kenya, KIFCON—a development cooperation project (£4.86 million) funded by the UK's Overseas Development Administration within a World Bank program known as *Forestry IV*—proposed a similar strategy. The project was implemented in the period 1990–1994 and was guided by the assumption that there was a fast decline of Kenya's forests because of the high demand for land and resources, exacerbated by population growth (KIFCON, 1993). The project aimed to conserve the indigenous forests of the country and to introduce joint forest management with the forest-dependent population (KIFCON, 1991). The project was conceived on two levels—the national level and the level of pilot areas. With the first one, KIFCON aimed to conduct extensive data collection, forest mapping, planning, and policy development. With the second, the project covered three areas of direct intervention, including the Southwest sector in the Mau complex. In particular, the project saw the population as the most significant factor putting pressure on the Southwest Mau. This view was motivated by the fact that at the beginning of the 1990s Mau was inhabited by dwellers consisting of Ogiek communities and squatters who had been living in the forest for various reasons, including rumors about a possible government forest excision for a conversion to settlement[3] (Bateson, 1993; RVPA, EC 1/6/14) and the return of the landless people after the 1992 political clashes in the Molo area (Daily Nation, 1993; Moorehead, 1993).

The intervention planned in the Southwest Mau was the resettlement of all the eligible squatters in the eastern part of the forest sector (24,000 ha); at the same time, the remaining part of the Southwest Mau (approximately 60,000 ha) would have been conserved with the cooperation of the local communities (Bateson, n.d.; KIFCON, n.d.). The decision to target the eastern section was due to the fact that this was considered by KIFCON as a "degraded" area with a low-value vegetation cover described as consisting mainly of grasslands and shrubs (Jackson and McCarter, 1994). In reality, the area was characterized by a fragmented and intermixed vegetation (Davies, 1993; Blackett, 1994), a detail

3 In 1985, 2,733 ha of the Southwest Mau sector were excised to allow the settlement of forest squatters in the Korau Settlement Scheme. The event created a significant precedent about the re-proposition of a similar opportunity.

that makes KIFCON's decision questionable and stresses the preference for a specific kind of "nature" (a high and dense tree canopy) that still persists.

In this framework, KIFCON was responsible for the census of the forest dwellers (1991–1993) in collaboration with the Kenyan Provincial Administration and under the supervision of the Office of the President and of the British High Commission (KIFCON, 1991; KIFCON, 1992). From the exercise, it emerged that in the forest were living 3,793 households or 18,044 individuals, of which 15% had been categorized as "Ogiek" and the remainder as "Non-Ogiek" whom KIFCON believed to belong to the Kipsigis ethnic group (Bateson, n.d.). In the end, the resettlement in the Southwest Mau never took place under the KIFCON project but in the following years (1996–2001) was led by the District Administration of Nakuru (see sub-chapter 2.3).

The ISLA-Kenya Project

Recently, a nature conservation program that recalls the "fortress" approach has begun operating in the Southwest Mau led by an international public–private partnership called Initiative for Sustainable Landscape-Initiative for Sustainable Trade (ISLA-IDH). The initiative is promoted by IDH, a foundation created by the Dutch Government in 2008 to foster public–private initiatives linked to sustainable development. In particular, ISLA focuses on promoting sustainable relations between society and the environment, mainly in tropical forests close to agricultural areas where big companies, particularly Dutch companies, have relevant interests. In the case of the Southwest Mau, the initiative is linked to the presence of tea plantations owned by the Anglo–Dutch company Unilever.

This initiative reflects two significant political changes. One is in international development cooperation, where the private sector is progressively more involved in what has been called a *post-aid era* (Mawdsley et al., 2013). The second is a shift in nature conservation where, since the 1990s, the private sector has entered a field that for decades was dominated by the state (Brockington et al., 2008).

The ISLA-Kenya program was established in 2016 to protect the Southwest sector of Mau with an initial budget of €3.7 million funded half by IDH and half by a large network led by Unilever Kenya and Finlays Kenya[4]. The approach is aimed at improving farm productivity around the forest, diversifying

4 For more information, see also https://www.idhsustainabletrade.com/initiative/isla-kenya/. The partnership is composed of the government organizations of the Kenya Forest Service, the Kenya Wildlife Service, the Kenya Water Tower Agency, the Water Resource Management Authority, and the Nyayo Tea Zone Development Corporation, with companies such as the Kenya Tea Development Agency, KENGEN, Safaricom, and the Timber Manufacturers Association. A few international cooperation agencies are present (GIZ, UK AID,) together with conservation organizations (SNV, Rhino Ark), a research institution (CIFOR), and local community associations (CFAs, WRUAs, Ogiek Council of Elders).

income-generating activities for the neighboring communities, and improving forest conservation (ISLA-IDH, 2018).

ISLA-Kenya's objective is to restore and conserve the Southwest sector that is considered to be alarmingly degraded due to several factors, particularly the pressure coming from the settlement area, although over the past decade this forest sector has not suffered from severe pressure and its dense forest cover is increasing, according to remote sensing analysis (see chapter 3) and the local community members interviewed.

ISLA and the partners work to reduce the animal presence in the forest in two ways. One is to regulate the current number of livestock (cattle and sheep) by implementing a grazing plan. The other is to promote stable livestock farming as a replacement for grazing within the protected area. According to ISLA's figures, the Ndoinet Forest hosts approximately 17,000 (KFS, 2019) or 22,500 animals (Korir, 2016) everyday, numbers considered unsustainable by the program. The first report quoted indicates in 6,104 tropical livestock units[5] (TLUs, corresponding to about 8,716 cows) the amount appropriate for the carrying capacity of the forest (KFS, 2019). The organization consequently proposes a progressive reduction in the number of cattle and the replacement of indigenous or hybrid cattle species with more productive dairy breeds to be raised in the families' stables.

However, these figures probably slightly overestimate the number of animals normally present in the area. With the aim of conducting a partial census of livestock using the Mau's pastures and in partnership with the non-profit organization Drone Adventure, in 2019 we conducted a drone remote sensing survey of 8,000 ha in the Ndoinet Forest section (total area 19,000 ha)[6]. The analysis first focused on the grasslands area located close to the forest boundary, and the first results (for a sample of 2,000 ha) allow us to highlight some important elements. First, just under 1,900 livestock heads have been counted, with slightly more sheep than cows. This is important, as the conservation initiatives currently in place focus solely on the grazing of cows. Second, there is no significant evidence of the permanent overnight stay of cows in the forest, another issue claimed by the conservation organizations. We recorded three traces of posts used as night shelters for the herders or of paddocks, the presence of which is prohibited by law. These kinds of structures are certainly present, as stated by some interviewees (2019), but probably occur to a much lesser extent than believed by NGOs and the KFS.

5 Tropical Livestock Unit is a unit of measurement used to compare the nutritional needs of different species of animals and is used to reference the amount of food fed to a 300 kg–400 kg adult cow.

6 The analyses of the drone images were carried out by Lucrezia Boiani, Andrea Colombo, Marco Cortesi, Giulia Gussoni, Armelle Mfoupou, Vittoria Olgiati, and Gaia Soldano.

The remote sensing analysis indicates the presence of less than one (0.95) animal per ha, a figure that differs significantly from the ISLA-IDH estimates (KFS, 2019) that counted 17,263 animals (cows, sheep, goats, and donkeys) grazing over 6,460 ha of grasslands and glades[7], which is an average of 2.67 livestock heads per ha. Something that usually escapes quantitative analyses based on carrying capacity is that the use of the forest for grazing is also influenced by the seasons (dry or rainy), the specificity of the cows (age, milked or kept only for meat), and the condition of the farm (the possibility of a surplus for feeding the cattle). In addition, one might think about organizing the grassland into grazing zones, programming more precisely the use of pasture and imposing livestock surveillance to better manage the activity.

Another intervention planned by ISLA-IDH concerns the creation of a physical boundary to the forest reserve, which does not exist today, with the aim of regulating and limiting the access of people and animals. The construction of an electric fence along the eastern boundary of the protected area (41 km[8], with 14 entrance gates) has been envisaged for this purpose. This artifact is officially justified by the need to resolve conflicts between humans and wildlife (e.g., elephants), while at the same time providing a physical separation that facilitates control by the Forest Service, particularly regarding illegal activities as timber extraction, charcoal production, poaching (Butynski and de Jong, 2016), which are present to a very limited degree[9].

The two main measures explained above are justified by an alleged link between forest degradation and human and livestock uses, the causality of which is weakly demonstrated by the research conducted. Therefore, the narration of the "grazing threat" seems to be used to justify fortress conservation measures that have been decided on a political rather than a scientific basis. The reduction of livestock units in the forest and the erection of the fence show an interest in creating a wild, intact forest cover that has never existed, at least in the last 100 years (Bally, 1946).

Drawing from the examples of KIFCON and ISLA-IDH, we identify the existence of a functional relationship between plantation agriculture and a specific nature (dense forest). This de-humanized forest is built materially through conservation programs and symbolically through an ecosystem services narrative that focuses on the hydrological and climatic functions of tropical forests.

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7 The research considered the Ndoinet Forest section plus the area beyond the Southwest Mau boundary, for a total of 28,000 ha, but the animals mostly graze in open areas.

8 In the feasibility study, the fence does not exactly follow the boundary of the forest but delimits the northern part of the West Mau sector and the southern part of the Southwest Mau from the settlements. For this reason, the length indicated is longer than the length of the forest boundary (32 km).

9 Personal communication with the local forest manager and forest rangers of the Ndoinet Forest (2018, 2019).

Fig. 7.1 - Electric fence in the Maasai Mau Forest sector (Narok County) (source: Stefania Albertazzi, 2022)

In this socio-ecology, grasslands, shrublands, and intermix vegetation cover appear to be a minor part of the nature, disregarded as an expression of a human presence or as evidence of livestock use. This "environmental narrative" becomes functional in relation to a neo-Malthusian approach (Ross, 2017) that blames the local communities and marginalizes them from the forest.

7.2 Community conservation

The second strategy is related to the community conservation approach developed around the 1990s as an alternative to "fortress conservation" and its heavy impact on local communities, in terms of dispossessions, human rights, and induced poverty (West et al., 2006). Community conservation is characterized by a variety of interventions that focus on the link between conservation and resource management through the active inclusion of the local community and with the aim to generate positive local impacts (Adams, Hulme, 2001).

The local communities around Mau Forest enter the forest to access several resources that are fundamental for their livelihood, particularly pastures and firewood. Other important forest activities include placing beehives on specific indigenous trees (see below, chapter 8), collecting medicinal herbs, collecting mineral salts for livestock, accessing cultural sites (caves, waterfalls), and hunting wildlife (which is an illegal activity).

Therefore, local communities consider the forest a sort of a resource pool containing communal products that each individual can access according to some formal and informal local rules (for this institutional approach to the study of natural resources, see Gibson et al., 2000; Haller, 2019). The legislation has regulated this human–nature relationship (RoK, 2005; RoK, 2016; KEFRI, 2016), creating the CFA and approving a number of official documents that codify the legitimate use of the forest's resources. In particular, forest community members can create a CFA with the aim of participating in the conservation and management of a state forest with the KFS by developing a *Participatory Forest Management Plan* (PFMP), which, together with a *management agreement*, guides future conservation and management measures. It is the signing of the agreement between the CFA and KFS that makes the PFMP operational, setting out the direction and the objectives of forest management, conservation, and use.

The problem is that the PFMP is an instrument the drafting of which is almost prohibitively expensive for local communities, being a technical document prepared by private consultants[10]. The plan presupposes conducting research on the biological and socio-cultural value of the forest, an in-depth investigation of the status of the forest and the way the local community uses it, and a final draft. Therefore, generally, the redaction of these plans is only possible with a contribution by external donors.

The approach outlined by the legislation and its implementation in the Mau Forest defines specific forest uses rather than a real power delegation reflecting a proper decentralized approach[11] (German et al., 2010). This relationship focused on resources translates into the CFA's structure and organization. At the lower level are *user groups* made up of people who practice the same activity or have a common interest. However, the *forest user groups* cover a wide range of activities, in some cases only marginally related to the forest. For example, in the village of Ndoinet we find the "Ndoinet farmer self-help group" that brings together farmers to discuss cultivation techniques, product trade, and tools on a monthly basis. There is also a "Table baking group" of 10–20 people who give each other money loans (e.g., to buy livestock or pay school fees). In several cases, participation in the CFA is motivated by a need to use the forest rather

10 Interview with D. G. from National Alliance of Community Forest Associations (NACOFA) (2020) and with G. N. from Kenya Forests Working Group (KWFG) (2020). The overall cost of research, writing, and officially proposing of the PFMP is probably around 15,000 € (personal communication, 2019).

11 The KFS is the legal manager of the public forests and grants management or conservation permits. It can terminate a *management agreement* or prohibit the enjoyment of a user right if it considers it necessary for conservation or if the CFA violates the terms and conditions of the agreement.

than by a marked interest in its management and conservation, highlighting a sort of functional approach to the forest.

At the same time, this extractivist relationship between forest and communities is fostered by the KFS itself. The KFS, for example, opposes the construction of permanent houses in Kiptunga Forest, protesting against the inhabitants when they see the replacement of thatched roofs with sheet metal roofs, which are perceived as more permanent[12]. Community members themselves are involved in several forest activities. For example, they patrol the forest to report fires, tree cutting, or charcoal production and are involved in the care of the tree nurseries, in reforestation activities, and in the management of grazing[13]. Community members are used as mere human resources to overcome the lack of personnel and to ensure an adequate payment of fees to the KFS.

7.3 Nature conservation with direct political purposes

A third form of conservation is marked by the manipulation of access to nature to pursue specific political or economic objectives. This approach is defined by land dispossession, in some cases violent, and by a tight political–economic entanglement. The narrative spread remarks the need to protect the natural forest and the water catchment from the pressure of peasants, to be realized through the eviction of people or the creation of buffer zones between the local communities and the forest.

Political evictions

In June–July 2020, part of the village of Mariashoni, adjacent to the East Mau Forest, was subject to an eviction implemented by the KFS, the Kenya Wildlife Service, and the police. One thousand individuals were removed from their homes, reclaimed by the three government agencies as part of the natural forest to be recovered and reconnected with the rest of the Mau complex. The operation targeted one of the settlement schemes created in the 1990s and was characterized by violence, which was aggravated by the timing of the operation that coincided with the Covid-19 pandemic and the rainy season. In the end, the eviction had a brutal impact on the local population; houses were cleared and burnt, people lost livestock and furniture, and some schools remained closed for some time. The exercise lasted a few weeks, during which the agencies evacuated an area of 2,000 ha–4,500 ha[14], and then it stopped because of a court case initiated by a ward administrator in Nakuru County. Currently, the local

12 Personal communication in Kiptunga (2022).

13 CFA members can generate a small but significant income from a well-structured tree nursery and a small allowance from participating to reforestation activities.

14 The first figure given is the result of a personal estimate following data collected in the field in 2022; the second figure refers to KNA (2020).

inhabitants can still enter their farmland to cultivate, but they are not allowed to rebuild houses, even though some of them are erecting temporary accommodation (built with mud and straw, with a few essential pieces of furniture).

This operation is part of a growing governmental use of violent methods against local communities. In fact, this eviction was anticipated by a similar but huge event in the Maasai Mau sector. In November 2019, 15,000 ha of Maasai Mau Forest (Narok County) were reclaimed, and about 10,000 families were removed with the aim of recovering a part of forest that was inhabited for a few decades with an uncertain legal status.

These interventions are part of a larger strategy via which, in the name of conservation and water tower protection, the government pursues political objectives. In fact, the evictions are linked to the shifting of alliances in the central government. The 2018 handshake between President Uhuru Kenyatta and previous rival Raila Odinga marked a distancing from Deputy President William Ruto (The Standard, 2020), a member of the Kalenjin ethnic group whose main electoral basis lies in this region.

In both the cases of the Eastern Mau and the Maasai Mau, the evictions were accompanied by a new land survey and by the establishment of new beacons on the ground with the aim of demarcating a new forest boundary. To that end, a 30-km electric fence has already been erected around Maasai Mau Forest.

The evictions not only impact the people removed from the villages but create hostilities between the various ethnic communities living around Mau (Ogiek, Kipsigis, and Maasai) that accuse each other of fostering evictions to regain possession of what they think belongs exclusively to one community. For this reason, in Mariashoni (East Mau area) and Kebenet (Maasai Mau area) police and army checkpoints are located along the roads, guarding the territory to prevent clashes[15].

Buffer zones

A different kind of conservation is centered on the role of tea plantations that, it is assumed, act as a buffer zone between smallholder farms and the Mau Forest. This approach has a rooted history in Kenya where, with the support of the World Bank and the creation of a specific agency—the Nyayo Tea Zone Development Corporation—since the end of the 1980s a 100-m wide tea plantation was created along the boundaries of the forests to protect them and foster tea production and local employment. The logic of the operation is to clearly demarcate the natural protected area boundary that lacks a physical separation from nearby farmland. The origins of the idea can probably be traced back to the implementation of the Integrated Conservation-Development

15 Observations and interviews during fieldwork (2022).

Projects[16] approach at the international level, which used *buffer zones* as areas of several kilometers where nature conservation and local community development coexist in the proximity of natural protected hotspots where more stringent protection could be implemented (Neumann, 1997).

In the case of Southwest Mau, this kind of intervention is visible around Kuresoi village (in Kiptororo) where the buffer zone has been initiated but then suddenly stopped after 10 km because the plantation spread far beyond the 100 m designated extension. The example of Mau has similarities with many other precedent cases where the country's élite (civil servants or politicians connected to the KANU party) used buffer zones as a subterfuge to seize and then convert protected areas into plantations and private property (Klopp, 2012)[17].

Fig. 7.2 - Tea buffer zone along the Ndoinet Forest boundary (source: Stefania Albertazzi, 2019)

We can trace a similar approach in the narrative of tea plantations in Kiptagich (Southwest Mau area). In the words of a manager in a leading position at the Kiptagich Tea Estate Limited, "The plantations play a dividing role between the forest and the farms and act to protect it"[18]. Actually, the plantations were

16 Integrated Conservation-Development Projects emerged in the 1990s as one way to overcome the "fences and fines" approach in conservation by promoting a program that simultaneously stimulates nature conservation and the rural development of communities.

17 It is interesting to know that the parastatal Nyayo Tea Zone Development Corporation was directly managed by the Office of the President and that its highest office was for a long time held by a Moi loyalist. This was Isaiah Cheluget (Hornsby, 2012), formerly Provincial Commissioner of Nyanza Province (probably in the period from 1969 to mid-1980).

18 Personal communication (2022).

created on natural protected forest areas of Transmara (another sector of Mau) in the second half of the 1980s and in Southwest Mau later on for the production of the tea brand Asis, which is connected to the family of former President Moi (Commission of Inquiry into the Irregular/Illegal Allocation of Public Land, 2005). In this second case, we observe an appropriation of public forest land for the personal benefit of President Moi, a process that later was used to justify a narrative of nature conservation to protect against the pressure of the peasants through a buffer zone. For both the evictions in Mariashoni and for the Kiptagich tea plantations, the common element is the instrumentalization of forest conservation for political and economic ends, taking advantage of an ambiguous legal situation (settlement schemes of Mariashoni) or of an old privileged (Moi family plantations), while at the same time blaming the peasants for the degradation of Mau.

8 Indigenous agro-forest systems

The last form of interaction between society and nature that we present refers to the indigenous agro-forest systems centered on the Ogiek people, the historical inhabitants of the Mau Forest. Before colonial times, the Ogiek communities used to interact, in terms of both conflicts and cooperation, mainly with the Maasai and Kalenjin people[1]. Politically speaking, like other hunter–gatherer groups in Africa, the Ogiek people were strongly marginalized by the government during and after the colonial period (Kimaiyo Towett, 2004).

The 1904 and 1911 Maasai agreements, which granted land to the British colonizers while forcing the Maasai to move off traditional lands, intensified competition for land in the Rift Valley region. The Ogiek started to be evicted from the forest (1911, 1926, 1932), and their land was declared Crown Land (1930s) or was allocated to white settlers or other tribes (in Nakuru, Naivasha, and Narok). Finally, their identity as a tribe was not recognized by the colonial administration, and there were repeated attempts to assimilate them into the largest ethnic groups, such as the Maasai or Kalenjin (Cavanagh, 2017). First under colonial rule and later under the independent government, they were marginalized and discriminated against because of their low number and irrelevant political power (Sang, 2001). After three decades of peace, a new phase in the socio-environmental conflict began in 1977. In that year, the national authorities moved against the Ogiek in Tinet (Southwest Mau Forest), arresting members of the community, destroying their houses, and accusing them of being illegal squatters. Since that time, the process of sedentarization described earlier (see sub-chapter 2.3) has intensified.

The Ogiek (about 52,000 in the country) mainly inhabit the Mt. Elgon area and the Mau Forest Complex (KNBS, 2019b), particularly the central sectors; in fact, Kiptunga is the only forest section in the entire Mau complex that has a number of villages (Kiptunga, Satellite, Tertit, Songi) within it (KFS, 2015). This is an exception, as permanent human presence in forest reserves is prohibited by legislation (GoK, 2016). In the last two decades of the 20th century, agriculture and animal husbandry began to play an increasingly prominent role in Ogiek subsistence, partly as a result of stable population settlement in the government-identified areas (35,000 ha in East Mau) within the Mau Forest (1994–2001).

1 The Ogiek ethnic group is usually considered close to the Kipsigis, a sub-group of the Kalenjin tribe, with whom they share a similar language.

8.1 An indigenous nature

What we call now the "primary" Mau Forest is actually the result of co-evolution between nature and the indigenous Ogiek people who helped shape it into its present form through activities such as shifting cultivation, hunting, herb and fruit gathering, and beekeeping (see sub-chapter 9.2), probably the core activity of the Ogiek territorial system, both in symbolic and material terms.

Therefore, the plant and animal biodiversity found in the indigenous forest is deeply connected with the Ogiek socio-territorial organization. In terms of vegetation, the species of greatest importance are those favored by bees (particularly the Dombeya (Silibwet/*Dombeya goetzeni*), those used as medicines or as building material for hives (Mororta/*Allophylus Abyssinica*, Saptet/*Podocarpus latifolius*, Aonet/*Polyscias Kikuyuensis*), and those that are important symbolically, such as the Podocarpus (Saptet), an extremely long-lived tree that marks the landscape with its large size. Gathering herbs, leaves, bark, and roots for phytotherapeutic use is a typical activity of all peoples living in contact with areas of forests and thus also for the Ogiek. Trees such as the staddo (*Rhamnus staddo*), the magic guarri (*Euclea divinorum*), the African cherry (*Prunus africana*), and the East African olive (*Olea capensis*), for example, have multiple medicinal uses for the local community. Wild fruit gathering is also common and is an important supplement to a diet that is otherwise rather poor, based mostly on maize, potatoes, cabbage, and milk.

Animal biodiversity remains significant in Kiptunga indigenous forest areas. These areas are still of great importance in the country, despite being affected by deforestation and intense anthropization in recent decades. Significant species mentioned by locals during participatory research include striped tragelaphus (*Tragelaphus scriptus*), the blue monkey (*Cercopithecus mitis*), the yellow-backed duiker (*Cephalophus silvicultor*), leopards (*Panther pardus*), and buffalos (*Syncerus caffer*). In addition, African forest elephants (*Lexodonta cyclotis*) are occasionally reported.

Hunting, practiced by men with bows, arrows, and dogs, is a fundamental part of the traditional socio-territorial organization. Hunting is prohibited in the protected area, so the information gathered on the subject is only partial. However, participatory mapping indicated as hunting areas the same areas that had been identified for honey and medicinal herb collection, namely, indigenous forest areas (see below, sub-chapter 8.3). Some informants reported a weekly hunting frequency and others a monthly frequency. The reported frequency may be different from the actual frequency, but it is probably true that the number of hunters is decreasing because game is no longer considered a primary food source.

Table 8.1 - Plants gathered as food and medicines in Kiptunga Forest (Trivellini, 2018)

Latin Name	English Name	Local Name	Service
Aloe vera	Aloe vera	Tangaratuet	Medicine
Cucumis metuliferus	Horned melon	N.A.	Food, medicine
Jasminum angulare	Wild jasmine	Ngambura	Food, ornamental
Euclea divinorum	Magic guarri	N.A.	Medicine
Ficus sur	Cape fig	Mogowet	Food, medicine
N.A.	N.A.	Botkawet	Medicine
N.A.	N.A.	Cockyiat	Medicine
N.A.	N.A.	Monyokua	Medicine
N.A.	N.A.	Chelolo	Medicine
N.A.	N.A.	Senetuet	Medicine
N.A.	N.A.	Usuet	Medicine
Olea europaea subsp. cuspidata	African olive	Emitiot	Food, medicine
Olea capensis	East African olive	Msaita	Food, medicine
Passiflora edulis	Passion fruit	Monjori	Medicinal, food
Physalis peruviana	Cape gooseberry	N.A.	Food
Prunus africana	African cherry	Tenduet	Medicine, timber
Rhamnus prinoides	African dogwood	Katrwet	Medicine
Rhamnus staddo	Staddo	Kosistiet	Medicine
Rhus natalensis	N.A.	Seriat	Medicine
Schrebera alata	N.A.	Lamayat	Food, medicine
Solanum incanum L.	Thorne apple	Sigowet	Medicine
Solanum nigrum	Black nightshade	Managu	Food, medicine
Urtica dioica	Stinging nettle	Thafai	Medicine, food
various species	Wild mushroom	Bobegmoriongig	Food
Physalis peruviana	Wildberries	Tagamamiat	Food

Usually, hunter–gatherer populations place great symbolic value on the forest, and the Mau complex is no exception. Indeed, this is where initiation ceremonies take place and where places of the highest cultural value to the community are located. The situation in the three protected areas analyzed is very different. In Koibatek Forest, which is more anthropized and has a lower percentage of Ogiek population in the neighboring villages, no cultural ecosystem services are mentioned. On the contrary, regarding Kiptunga Forest and Ndoinet Forest, the indigenous forest is still an important place from a symbolic point of view. Caves, waterfalls, and trees of particular sizes, particularly *Ficus thonningii/natalensis* and African cedar (*Juniperus procera*), are mentioned among the most relevant aspects.

Therefore, the main characteristic of these parts of the Mau Forest from a material and symbolic point of view is that it is simultaneously a naturally growing forest with considerable environmental value, and an inhabited forest, as opposed to more rigid conservation practices. The strong interpenetration between nature and society emerges particularly clearly in the case of beekeeping.

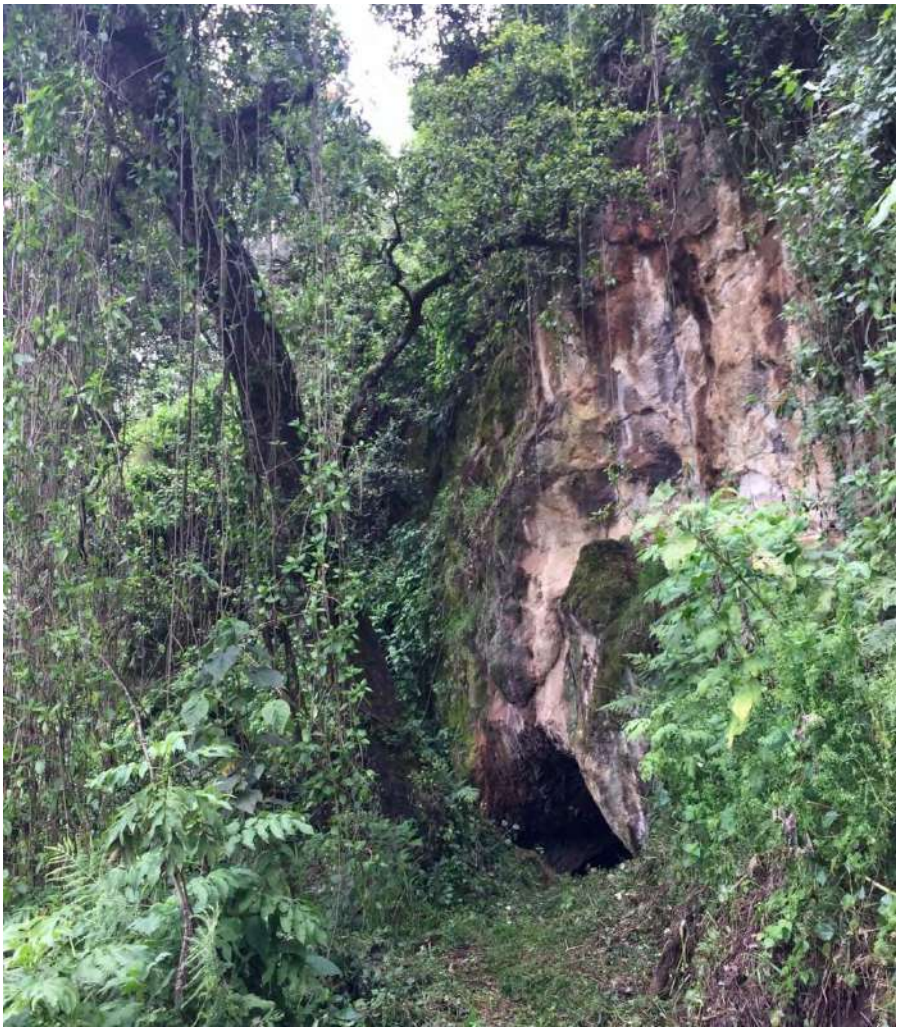

Fig. 8.1 - Cave used for rituals in Kiptunga Forest (source: University of Milan, 2020)

8.2 Beekeeping

Honey plays a key role in the culture of forest-adjacent people. In addition to its use as a staple food, the Ogiek people also use it as a medicine and in community rituals. Traditional beehives are set up on indigenous trees (e.g., *Dombeya goetzenii*) at a height of 5 m–10 m, and twice a year honey is harvested by climbing the trunks. This is a complex process. The beekeeper produces a small fire using local moss, and then this moss is carried up the tree in a leather bag so the harvester can drive the bees away with smoke (Fig. 8.2).

Traditional honey harvesting is deeply related to the quality of the vegetation. First, traditional hives with a typical cylindrical shape are constructed by carving the trunk of some indigenous species, particularly Saptet (*Podocarpus latifolius*), Silibwet (*Dombeya torrida*), Aounet (*Polyscias Kikuyuensis*), and Tenduet (*Prunus africana*) (Albertazzi, 2020; Zocchi et al., 2020). Second, the interviews showed that the areas most used for beekeeping are those characterized by native vegetation and that are less fragmented by fields and exotic tree plantations. However, more recently beekeeping activity has expanded to more anthropized areas where people use modern hives, especially close to waterways where richer and more diverse vegetation remains.

Lately, a number of international cooperation projects have supported traditional and modern beekeeping activities by enhancing local groups. In the research area, the most structured cooperative is undoubtedly Macodev (Mariashoni Community Development), which operates in the village of Mariashoni (Nakuru County) and was formed in 2013 in the framework of an international project implemented by a local NGO (Necofa) and three Italian organizations (Mani Tese, Slow Food, and WWF). Macodev is a kind of umbrella organization officially consisting of 97 members belonging to eight self-help groups. The cooperative promotes local development in the village of Mariashoni, and its main activities are in three areas—the production and sale of honey, the promotion of ecotourism in the forest, and the management of an Ogiek radio station created in 2020. Since its establishment, Macodev has been involved in different projects, and this continuity has allowed the cooperative to participate in beekeeping training and business management and has enabled the organization itself to receive equipment and resources to promote its activities.

During the period 2013–2020, Macodev appeared to be continuously active, although very low production was recorded for 2 years (2018 and 2020). The quantities of honey produced were the highest in the first years of the cooperative's existence, which coincides with the project support and the conferment of the title "Slow Food Presidium"[2]. Over the 2014–2017 period, the amount of raw honey processed by Macodev was between 1,400 kg/year and 1,600 kg/year, allowing the production of 1,100 kg–1,250 kg of refined honey, generating an annual profit between 215,000 KES and 250,000 KES (1,700 €–2,000 €).

2 A Slow Food Presidium is an award given by the Slow Food Organization to traditional products that are distinguished by the richness of the heritage of knowledge and culture from which they are produced, by the distinctiveness of the area of production, and by the mode of production. The Presidium project was born in 2000 as part of the organization's strategies to safeguard traditional culinary products placed at risk of extinction, to preserve their existence and practices of production, and to enhance the territory in which they are located. Currently, there are 600 Presidia in 70 countries (https://www.fondazioneslowfood.com/it/cosa-facciamo/i-presidi/).

In 2019, 1,300 kg of raw honey was estimated to be received, with a profit of 195,000 KES (about 1,500 €); while 2020 was a difficult year in the Mau Forest area, with the delivery of only 500 kg and a refined honey production of 375 kg, for a profit of 75,000 KES (just under 600 €). Honey market networks are extensive and benefit from Macodev's many partnerships, the favorable location of the store in the village next to the offices of the KFS and the local Chief, and contacts generated by national and international organizations. Honey consumers include government officials and staff of partner organizations, tourists who come to Kiptunga Forest, and attendees of national and international events in which Macodev participates.

In the Southwest Mau sector the Ndoinet Honey Producers' Cooperative (NOHPA) has been active since 2018. The cooperative evolved in close relationship with the CFA, the association that brings together villagers living near the forest as part of another international cooperation project funded by AICS. As in the case of Macodev, the operation of the cooperative is quite simple. It buys honey from members (200 KES/kg) and refines it to sell it in the same production area at a higher price (600 KES/kg). The 179 members own 900 hives and pay a fee of 100 KES (0.80 €) to join the cooperative. Production increased over the three project years but remained at a very low level, stopping in March 2020 at the end of the project. Honey harvesting increased from 50 kg in 2017 to 150 kg in 2019, while the value of refined honey sold has increased from 8,000 KES to 24,000 KES per year (60 €–180 €). The causes of the difficulties are diverse but generally relate to the cooperative's dependence on the project that fostered its genesis.

The area is not a particularly relevant market center, but it had attracted some interest partly because it is close to the construction area of the Itare Dam, a major infrastructure project that started in 2016. The initiative mobilized about 1,000 workers, some from the area and some migrants from elsewhere, who were expected to constitute, at least for a time, a potential market for the cooperative. However, construction work on the dam stopped in 2018 and has not yet resumed, leading to a significant drop in the number of people in the area and less willingness to buy on the part of the resident population left without work. The end of the project also meant that the staff of the organizations involved, which represented a significant portion of the buyers, were in the area less frequently. To these critical issues must also be added climatic difficulties; prolonged rains between the end of 2019 and the beginning of 2020 hindered the normal harvesting times (generally in the months of February/March). Although the members installed beehives with specific rain cover, these difficulties weakened the cooperative's foundation that had been laid by the project. Interviews with cooperative managers revealed an intention not to abandon the project and to revive it with the 2022 harvest, but the structural conditions of this cooperative remain extremely fragile.

Finally, in 2020 the Koibatek CFA began to develop a beekeeping cooperative with the support of the project *Agrichange* funded by AICS and implemented by Necofa and the Italian NGO Mani Tese. Today, the cooperative has 150 hives, some traditional and some modern, and produces 150 kg–200 kg of refined honey per year. The project ended in 2022, and the major challenge for the future is to assure economic sustainability.

Fig. 8.2 - Honey harvesting in Kiptunga Forest (source: Stefania Albertazzi, 2022)

8.3 Participatory mapping of ecosystem services

In Kiptunga, we conducted rapid participatory research to assess the distribution of indigenous activities within the boundary of the protected area (Albertazzi et al., 2018) and thus to identify the most important spaces for the local community. Concerning hunting activity, informants indicated that the

hunting zones cover an area of about 4600 ha. Furthermore, villagers reported that some species were not locally available anymore, after moving to larger areas of the forest (namely the buffalo, *Syncerus caffer*, moved to Chebuin). The areas of the rainforest indicated for beekeeping have a surface area of about 4360 ha. Regarding this activity, some comments underlined a certain mortality rate of bees due, according to the community, to the relatively recent use of fertilizers in local agriculture. Mapped plant gathering areas for medical, cooking, or other non-timber uses have a surface area of 2590 ha. The community reported a list of 25 forest products (plants). For gathering activities, the informants reported the generic need for the community to take much longer walks in the forest to find the useful plants compared to the past.

Of the 5600 ha identified as a source for any of the three ecosystem services, 1860 ha (33%) were mapped as important for the use of all three services, 2030 ha (36%) for the use of at least two of them, and 1710 ha (30%) for only one of the three services provided by the forest to the community (see also Albertazzi et al., 2018).

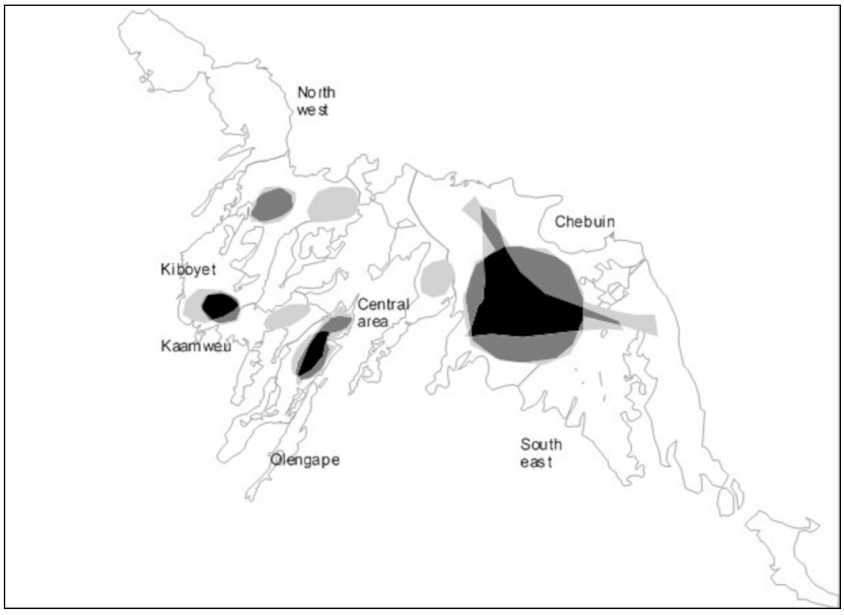

Fig. 8.3 - Hotspots of ecosystem services in Kiptunga (Albertazzi et al., 2018). The polygons indicate one mapped ecosystem service (light grey); two overlapped ecosystem services (dark grey); and three overlapped ecosystem services (black).

8.4 Ecotourism

The last activity that directly refers to the indigenous forest is the development of ecotourism. Tourism in the Mau Forest has great potential but suffers from competition from areas of great wildlife value, such as the savannah parks in the southern part of the country. The elements of interest are the naturalistic scenery and the cultural heritage of the Ogiek communities. For this reason, the small ecotourism initiatives that have been developed have sought to enhance the distinctiveness of certain ecosystems and thus the indigenous forest areas.

In the research area, only the Kiptunga section is actively involved in ecotourism, due to the presence of a strong Ogiek community and to the relative accessibility of the area. We can highlight two major initiatives—the actions by Macodev centered in Mariashoni and the projects developed by the CFA in the area around Satellite, one of the Ogiek villages located within the boundaries of the protected area.

In the Mariashoni area, the development of responsible forms of tourism was fostered by the international cooperation project mentioned earlier (see sub-chapter 8.2, 2014–2016). Thanks to funding from an Italian philanthropic foundation (Fondazione Cariplo), it was possible to set up a number of trails and vistas within the forest, and a local travel agency called Terra Madre was started, which is still the main carrier of tourists in the area.

As part of the same project, an accommodation facility was built in Mariashoni, which also serves as an Ogiek cultural center. Ten community members were trained as operators and to engage in various other activities to promote the local economy and protect the forest. Numbers are limited to a few hundred visitors per year, but still relevant is the activation of local development dynamics that are associated with the Macodev cooperative and that are focused on forest conservation and the enhancement of Ogiek culture.

The second initiative in this sector is promoted by the Ogiek community itself and aims at developing ecotourism in the forest by enhancing the Ogiek cultural center located in the forest, close to the village of Satellite. Currently, some members of the Ogiek community work as guides for occasional ecotourism excursions in the indigenous forest organized mainly by the Terra Madre travel agency. However, in these cases tourists rely on accommodations outside the forest, such as the ecolodge in Mariashoni. The project, started in 2021, aims at using the space of the cultural center as a base for ecotourism in the forest, with the development of ecocamping within the boundary of the protected area. It is too soon to know if the project can be successfully implemented, especially in the tourism sector that has been jeopardized by the pandemic crisis. However, the initiative shows that the Ogiek community is trying to reimagine its cultural and environmental heritage, connecting it to international networks.

9 Conclusion

The Mau Forest represents a socio-environmental heritage of international significance and is a fundamental environment for the communities living within and around the protected area. Therefore, its protection and the development of a sustainable relationship between human communities and the forest must be a priority for all institutions on both the local and international scales. In the framework of the United Nations' Sustainable Development Goals (SDGs), the protection of the Mau Forest is directly linked with the achievement of Goal 13 (fight against climate change) and Goal 15 (protection of terrestrial ecosystems), but it is also strategic for the pursuit of SDGs 1 (fight against poverty), 2 (fight against hunger), 6 (access to water), and 7 (access to energy). Finally, it should not be forgotten that the area has been the site of major political conflicts, and therefore proper management of this strategic space also ties in with the achievement of Goal 16 (peace).

Today, the forest is not undergoing major deforestation processes after a period in which it saw a remarkable reduction in its area, culminating in 2001 with the conversion of 60,000 ha of forest to agricultural land. Along with this "institutional" deforestation, however, there has also been a more informal deforestation involving uncontrolled private use of the protected area.

State policy has played a leading role in the evolution of the protected area, first with the contested allocation of forest land for agricultural purposes and then, with the change of government in 2002, with a renewed protection policy that also led to forceful actions, such as the removal (2001–2008) of irregular inhabitants from the forest. The result is that today the forest is indeed stable but also highly vulnerable, threatened above all by its fragmentation that hinders biodiversity conservation efforts. This fragmentation is the result of several factors—an institutional structure of the forest divided in 22 sectors, of which only 16 are contiguous; the settlement schemes that eroded the protected area and produced new forms of anthropogenic pressure on the forest; and the presence of significant percentages of tree plantations that, while playing an important economic role, do not guarantee real continuity in ecosystemic terms.

Today, the main anthropogenic pressure, particularly in the Ndoinet area, comes from the use of the forest as a source of firewood and as pasture for animals, particularly cattle. From the energy point of view, the area under study is still largely dependent on firewood from the forest. If, in fact, people are beginning to use the electricity grid or photovoltaic micro-plants for lighting, cooking, and heating, biomass burning remains the almost exclusive source of energy supply (KFS, 2015; KFS, 2018). During the research conducted in Ndoinet, all members of the local community surveyed relied on wood as their

primary energy source, meaning that the forest remains the primary source for this wood. Our estimates indicate that, with a population of 37,000 households, traditional cooking (i.e., three-stone stoves) consumes more than 100,000 tons of wood a year, a significant amount both environmentally and socially, given the fact that women are usually in charge of collecting wood in the forest.

As for cattle, the most problematic situation is in the Ndoinet Forest, an area regularly used as pasture by the nearby populations. Here, estimates vary considerably. The ISLA program that aims for a substantial reduction of grazing in the forest has indicated there are about 17,000–22,000 animals present daily in the Ndoinet section. We consider these numbers to be excessively high and estimate the presence of cattle in the forest during the dry season (the one with the highest presence) to be less than 10,000 heads.

In any case, anthropogenic pressure in the three sections considered does not seem to be such as to jeopardize the existence of the vegetation, which appears on the whole to be stable (Koibatek, Kiptunga) or regrowing (Ndoinet) and properly co-managed by the KFS and local communities (CFAs). The situation appears more difficult when projected into the medium and long terms, particularly in a context of intense demographic growth: the local population increased by about 40% in the decade 2009–2019 – the first period after the formal settlement of the communities – and now has a density of about 300 dwellings/km^2, a high value for rural areas on the continent. Therefore, in the coming decades the pressure of the population living around the forest and also the demand for arable land at the national scale will be increasing. In the absence of a rethinking of agricultural development strategies, this dynamic represents a major risk factor for the forest.

Along with these political and demographic processes, the evolution of infrastructure in the region will also need to be monitored. While the construction of the Itare dam (now suspended) does not appear to pose a danger in the southwestern sector of the forest, the impact of the Bosto Dam project[1], currently under study, appears decidedly more critical.

The Mau Forest thus presents itself as a socio-environmental hotspot, an area of great natural and cultural significance and simultaneously an extremely vulnerable space in the face of multiple socio-political risks. The protection of this heritage is therefore a strategic factor for any sustainable development policy on a national and an international scale.

However, to promote this strategic protection it is first necessary to remove the forest from the narrative of a homogeneous and pristine space, restoring to it its own image of complexity. Actually, the Mau Forest hosts many different forms of forests that are the outcome of a co-evolution between nature and the

1 In 2017, an Environment and Social Impacts Assessment Study Report was published for the construction of a 252-ha reservoir on the Kipsonoi River within the Southwest Mau protected area (National Water Conservation & Pipeline Corporation, 2017).

actors living in and around the protected area. Indeed, only by recognizing this complexity will it be possible to construct specific conservation and development policies tailored to the specific characteristics of the forests and the actors involved. The following proposals therefore seek to identify different strategies in the different areas researched.

1. Guaranteeing the forest boundaries

Ensuring that no further loss of forest area occurs is essential in order not to further parcel out an already fragmented protected area. The three forests are equally exposed to the risk of formal excision (as happened in 1985 and 2001 with a state-promoted degazettement) or informal stable human occupation of the protected area (as occurred in the years 2001–2008). In the case of the Ndoinet Forest, for example, the eastern boundary in contact with the agricultural area seems to hold and be respected. However, in the southern part close to former President Moi's plantations in Kiptagich, the boundary of the protected area is not clearly defined, and encroachments are present in an area of about 2,000 ha. Fires are also more frequent in the southern area, a possible indicator of stronger pressure from agriculture and grazing in the forest reserve. Beyond the specific case, it is important to highlight the importance of a clear boundary-safeguarding policy, not in terms of physical patrols or army defense, but in terms of safeguarding the current forest reserve extension. This would be essential to address a possible increasing pressure on resources that could lead to the creation of informal settlements or state-legitimized settlements, particularly in the previously occupied Ndoinet area.

2. Reconnecting or densifying the forest

To reverse the fragmentation process, it is possible to foster the connection between the different forest sectors by carrying out targeted reforestation works, even in limited areas. Within the research area, two sections seem particularly prone to a fragmentation problem—the forest between Mount Londiani and the western sector and some western portions of the East Mau section (Fig. 9.1). In these areas, there would be a need to negotiate with local actors the replacement of small portions currently in agricultural or forestry use with areas of indigenous reforestation that would allow reconnection between crucial sectors of the forest.

In the degraded sections, forest can be densified with reforestation processes, starting from internal areas (west to east, in the case of Ndoinet Forest). The process can start filling the smallest gaps, thus maximizing the dense forest areas with a minimum effort, then proceed to larger degraded areas, only after having secured a large area of stable forest.

With the intention of supporting spontaneous regrowth of vegetation, a micro-fencing practice has been implemented in Ndoinet, in which a few hectares of forest are fenced off by CFA members and closed to grazing for a limited period of time (3–5 years) with the aim of encouraging the rehabilitation of vegetation cover.

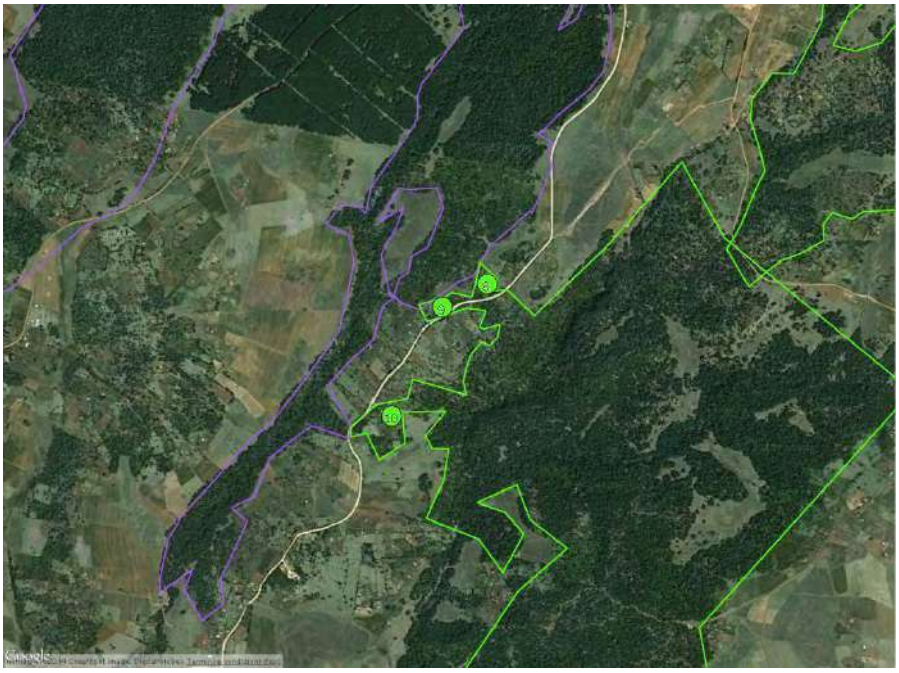

Fig. 9.1 - Example of forest fragmentation and identification of contact points for ecological corridor drawing in the East Mau Forest (Trivellini and Lindon, 2014)

3. Local communities at the center

Local communities are an unavoidable actor in building a sustainable future for the Mau Forest. In the past, colonial and post-colonial governments implemented authoritarian forms of conservation that severely disadvantaged communities living around and within the forest. Even some contemporary conservation initiatives pursue top–down conservation strategies, such as implementing physical barriers between the forest and the communities. In our view, such arrangements are a mistake because they institutionalize a division between human groups and the protected area that hinders the development of shared land management and the integration of environmental protection and human activities.

With the establishment of CFAs, Kenya has embarked on a path of co-management of protected areas that has several interesting elements from a formal point of view. At the practical level, however, such co-management often remains to be built, the redaction of the participatory plans remains too expensive, and CFAs are still very weak. Therefore, there is a need to work on institutional strengthening so that these communities can take the lead in a renewed relationship between humans and nature that will lay the foundations for the future of the Mau Forest. For this to be possible, it is crucial to support local initiatives to diversify the production model in the key sectors of agriculture, energy, forestry activities, and sustainable tourism.

4. A renewed agriculture

At present, the communities living around the forests analyzed base their livelihoods essentially on a production model based on small-scale properties (2 ha on average) that combine the cultivation of maize, potatoes, and cabbage with extensive cattle and sheep farming. Usually, this consists of conventional agriculture supported by chemical inputs that are dumped downstream, even if some experimental organic farms are developing in the area. With current population growth rates, this model risks becoming unsustainable, pushing towards new forms of forest appropriation and degrading water quality in the Rift Valley and Lake Victoria watersheds.

To ensure sustainable development for these communities, it is necessary to accompany a transformation of production strategies oriented more toward product quality rather than quantity. Diversification of agriculture, agroforestry, organic farming, and diversification and improvement of livestock husbandry are possible strategies to pursue. For this to be possible, however, it is necessary for the products of these activities to find a connection with the rapidly developing regional and national markets.

The state-owned areas of the PELIS program currently devoted to conventional and undiversified agriculture could function as a laboratory aiming toward agriculture with less environmental impact and greater economic and social value added.

5. New energy

Local communities living around the forest often lack access to the power grid, mainly because they are too poor to afford a connection. This issue is particularly present in less accessible areas, such as those adjacent to the Ndoinet section. While working on improving the living conditions of communities, initiatives that aim to reduce firewood consumption through technologies within the reach of households should be supported. Improved stoves, micro- and mini-solar panels, and biogas are some concrete examples.

6. A new forest economy

For centuries, the Ogiek people have used the forest for economic (honey and fruit harvesting) and socio-cultural (gathering of medicinal herbs) activities. A part of the strategy to diversify the economy could be to enhance these activities. International cooperation projects have led to the Slow Food Presidia recognition of some local food products from the Mau Forest area, such as Ogiek honey, dried nettles, Molo sheep, and *mushunu* chicken. Regarding honey in particular, it was possible to start a marketing activity managed by the local community that now functions independently. More recently, however, the local community has been trying to enhance the medicinal herbs that are harvested in the forest. These activities alone do not allow families to be self-sustaining, but when linked with the others mentioned above they can contribute to the development of a sustainable relationship between local communities and the forest.

Such initiatives take on particular value in areas where the roots of local communities are strongest, such as Kiptunga Forest and Ndoinet Forest, where the Ogiek people have the largest and most active presence.

7. A new tourism

Sustainable tourism is not an easy and immediate answer to the needs of the population. Today, many basic infrastructures (roads, lodging, trails) are lacking, and the Mau Forest is in fact competing with world-renowned tourist hotspots located only a few tens of kilometers away (e.g., Lake Nakuru, Maasai Mara Park). However, with limited and targeted investment, it would be possible to attract niche tourism to the area that is interested in forest excursions and in encountering the local communities. Such a tourist presence is compatible with the protection of the forest and could help enhance its conservation. Not all areas lend themselves to this type of activity, as only areas of indigenous vegetation and strong socio-cultural cohesion (e.g., Kiptunga and Ndoinet) have sufficient elements of attractiveness to compete in an already highly developed market such as Kenya.

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Forest and Communities
Deforestation, Conservation, and Socio-ecological Relations in the Mau Forest, Kenya

Stefania Albertazzi, Valerio Bini, Guido Trivellini

The book analyzes the case of Mau Forest (Kenya), exploring the deforestation process that has occurred and the controversial and changing relationships between a protected forest and the communities living within and around its borders.
The volume contributes to the international debate on political ecology from a predominantly geographical perspective, enriched by contributions more closely related to the natural sciences. The study is based on a multi-year research (2017-22) that combines qualitative and quantitative methodologies: research in archives and government offices, field studies in the forest area, semi-structured interviews, participatory mapping with local community members, and satellite and drone remote sensing.

Cover Image: *Electric fence in a contested area of the Mau Forest's southern sector*, by Stefania Albertazzi, 2022

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