

# Assessment of the biodiversity in terrestrial landscapes of the Witu protected area and surroundings in Lamu County, Kenya

*Mordecai Ogada, Grace Koech and Josephat Nyongesa*



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## LIST OF ACRONYMS

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ASDSP	Agricultural Sector Development Support Programme
BMP	Biodiversity Management Program
CBNRM	Community-based Natural Resource Management
CBO	Community-based Organization
CFA	Community Forest Association
EET	Eastern European Time
EMCA	Environmental Management and Coordination Act
EU	European Union
FR	Forest Reserve
GIS	Geographical Information System
HH	Household
HWC	Human Wildlife Conflict
IBA	International Bar Association
ICRAF	World Agroforestry Centre
IGAD	Intergovernmental Authority on Development
IUCN	International Union for Conservation of Nature
KDF	Kenya Defence Forces
KFS	Kenya Forestry Service
KMFRI	Kenya Marine and Fisheries Research Institute
KPF	Kipini Provisional Forest
KWS	Kenya Wildlife Service
LAKWA	Lake Kenyatta Water Association
LAPPSET	Lamu Port South Sudan-Ethiopia Transport Corridor
NEMA	National Environment Management Authority
NGO	Non-Governmental Organization
NLC	National Land Commission
NMK	National Museums of Kenya
NRT	Northern Rangeland Trust
PAC	Problem animal control
PELIS	Plantation Establishment and Livelihood Improvement Scheme
PFMP	Participatory Forestry Management Programme
REDD	Reducing Emissions through Deforestation and Forest Degradation
TNC	The Nature Conservancy
VMS	Virtual Memory System
WCMA	Wildlife Conservation and Management Act
WFE	Witu Forest Ecosystem
WRMA	Water Resource Management Authority
WRUA	Water Resource Management Association
WWF	World Wildlife Fund for Nature

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## ABSTRACT

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This paper has examined the current state of terrestrial biodiversity in Witu area and its surroundings in Lamu County, Kenya. The report covers a synthesis of threats, and current management interventions in place. Overall, the survey has found that the cross-border area of north-eastern Kenya and southern Somalia are highly diverse and threatened biodiversity areas. This is illustrated by the high concentration of endemic species (approximately 550 plant, six mammal and nine bird species), not to mention more arthropod species. It is also relatively underdeveloped with high incidences of poverty and consequently significant pressure on ecosystem services from local communities. The most important single source of pressure on the ecosystem is from the extraction of wood from forests. There is a long-standing dependence on wood for construction of houses, boats, and manufacture of furniture and domestic fittings, which require harvesting of large old tree species. As a result of this, several forest specialist species, such as the wood owl, crowned eagle and straw-coloured fruit bat are threatened, despite not being directly targeted by any of the forest users. These threats to the ecosystem are exacerbated by its cross-border area of north-eastern Kenya and southern Somalia. The final key challenge is the rapid development of infrastructure under Kenya's Vision 2030 initiative.

In light of these challenges, the IGAD BMP project implemented a number of interventions to create and strengthen ecosystem co-management between statutory and civil society agencies in Kenya and Somalia, respectively. Under Kenya's Vision 2030, this area is targeted for several development initiatives in the energy, mineral and transport sectors. It is therefore expected to be a crucial component that must precede the planning process.

This study recommends upscaling of the current conservation, management and education efforts, as well as improvement of the local communities' capacity to manage natural resources and development processes for sustainable implementation and management of the same.

## BACKGROUND AND RATIONALE

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The Biodiversity Management Programme (BMP) is an IGAD initiative funded by the European Union (EU). The programme aims at contributing to poverty reduction by improving the social and economic wellbeing of the population in the IGAD region, through better regional integration in the environmental sector. Its purpose is conservation and sustainable management of ecosystems in the IGAD region, in order to contribute to lasting goods and services. BMP supports conservation and biodiversity management in three sites in the Horn of Africa; the Boma-Gambella Landscape (southeast Sudan and southwest Ethiopia); the Lower Awash-Lake Abbe Landscape (northeast Ethiopia and south west Djibouti) and the Tana-Kipini-Laga Badana Bush Bushle Land and Seascape (northeast Kenya and southeast Somalia).

ICRAF is one of the principal IGAD BMP implementing partners to three projects financed through the IGAD Biodiversity Management Programme in the Horn of Africa to develop collaborative management in three cross-boundaries, land and seascapes between Kenya-Somalia, Djibouti-Ethiopia and Ethiopia-South Sudan. ICRAF is managing the Tana-Kipini-Laga Badana Bush Land and Seascape (northeast Kenya and southeast Somalia).

This survey aimed at compiling and synthesizing existing, and where possible, new information on the terrestrial biodiversity in the Witu intervention sites in Lamu County, Kenya. The ultimate purpose was to provide stakeholders in the cross-border area with information on the biodiversity and benefits derived from this initiative, to raise their understanding of threats, appreciate biodiversity related opportunities and recommend possible action. The Tana-Kipini-Laga Badana Bush-bushle Land and Seascape (northeast Kenya and southeast Somalia) is an important area with rich biodiversity. The area is in transition phase, with several opportunities in infrastructure growth, natural resource exploitation, and tourism. However, this area also faces a number of human-mediated threats including environmental degradation by unsustainable socio-economic development, local use of natural resources and insecurity. These unsustainable and anthropogenic factors if not managed, will pose a major threat to the environment

## METHODOLOGY

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### Desk review

This involved examination of existing biodiversity reports from work done in and around the area, mainly from ICRAF, the National Museums of Kenya and Nature Kenya. These were accessed by visiting the Nairobi headquarters of the respective organizations, as well as their field offices. Where possible, it also involved direct contact with the researchers involved in collecting the field information the authors were interested in. The major challenge in the compilation of this data was the nature of the northern coast of Kenya and inaccessibility due to insecurity and lack of infrastructure.

### Government agencies

The study drew on a number of sources of existing information about biodiversity and natural resource management in the demonstration area. This included Lamu County and central government offices in the area:

- i. Regulatory agencies including Water Resources Management Authority (WRMA) and Kenya Forest Service (KFS) provided information on the availability and use of water and forest resources, respectively. This included quantities, number of users and their location, as well as sustainability.
- ii. One team visited the Northern Rangelands Trust office at Lewa Conservancy in a bid to consult officers on the community conservation structures and existing natural resource management plans in the area, particularly in the community conservancies.
- iii. Kenya Wildlife Service (KWS) research records were consulted to establish whether the Witu Forest is a habitat for endemic or endangered wildlife species, and which parts of the forest are most important for conservation of the same. This was supplemented by research information from National Museums of Kenya (Mammology Section). Reference has also been made to the aerial wildlife census done by KWS in 2015.
- iv. National Museums of Kenya (Ornithology Section) provided valuable information on

avifauna from surveys done in the area, as well as expert services to confirm the identity of specimens photographed by the BMP consultant during the field trip.

## Review of existing knowledge and stakeholder engagement

The approach taken when collecting data for this report was one-on-one interactions with various stakeholders in and around the Witu forest ecosystem, such as the local community, KFS, KWS and National Museum of Kenya (NMK) officials who live and work near the forest. First, the authors collected information on Witu and other northern and coastal forests from various institutions in Nairobi that have conducted biodiversity work in the forest, including NMK, Nature Kenya and KWS. Visits to Northern Rangeland Trust (NRT) offices at Lewa Wildlife Conservancy in Isiolo were made to obtain information from the organization's ongoing and planned community conservation initiatives in Lamu County. This was followed by a visit to Lamu in a bid to interview local stakeholders as well as obtain copies of information held by local offices of government regulatory bodies.

## Field visits

Additional visits to Lamu were made to interviews with relevant stakeholder and two field excursions to the north and south of Lamu (Boni and Witu forests respectively), as well as a rapid survey of Manda, using local guides. This was made possible through field observations of birds and mammals and their habitats. The survey concentrated on these two taxa for the following reasons because they can be seen with ease and sensitive to changes in the habitat making them useful indicators to biodiversity managers and landscape planners, who are key audiences of this report.

This report also includes data collected from different offices like the KFS headquarters in Karura Forest, Nairobi, and the KFS office in Witu Forest. Data was also collected from KWS in Nairobi and NMK in Lamu.

## Sources of information

The available biodiversity information on the project area was spread out amongst different organizations based on their different institutional agendas. It was therefore necessary to approach a variety of different institutions. The government/regulatory organizations provided continuity in information because of their mandate, which keeps them there permanently. The civil society/NGO sources provided more in-depth information because they were better resourced over the duration of their projects.

## Field survey reports

Due to the high level of endemism and unique species in the area, the team also used information from unpublished biodiversity surveys (particularly focusing on mammals and birds). They also undertook a 3-day field visit to the study site in May 2016, where key respondents were interviewed and direct observations made. They visited the Mokowe mainland area and Manda Island, both of which are likely to be affected by the Lamu Port-South Sudan-Ethiopia Transport (LAPSSET) development.

## THE AREA

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### General geography

Witu Forest is located in the coastal county of Lamu, one of the 47 counties of Kenya. Covering approximately 4639.9 hectares, the forest reserve was gazetted under Legal Notices No. 454 of 1962 and No. 81 of 2000. The ecosystem is generally flat and lies between 0-50m above sea level. The low altitude exposes some part of the ecosystem to flooding during the rainy season. These flood-prone areas include Lake Kenyatta and Mpeketoni.

The ruins of at least five ancient Swahili settlements have been identified in the Witu Forest Ecosystem (Mpeketoni, Wanafa, Sabaa, Kamwana and Shaka). They are clustered around Rasya Mwana which lies within the WFE boundary. The northern Kenyan coast has a long historical trading connection with Oman, dating back to 800 years. In 1332 a famous Moroccan explorer, Ibn Battuta, landed in Malindi, which lies 130km south of Kipini (Ochieng 1975).

Witu Forest Ecosystem comprises a remnant coastal forest identified as a global biodiversity hotspot. The ecosystem however, is facing a myriad of current and imminent threats such as illegal logging, slashing and burning for agriculture, infrastructure development due to the LAPSET project, as well as onshore and offshore oil and wind energy exploration and security initiatives (Musila et al 2015).

**Table 1: Components of Witu Forest Ecosystem**

Name of forest	Legal notice	Legal instrument	Area (Ha)
Witu Forest Reserve	454 of 1962	Forests Act 2005	3937.6
	81 of 2000	Forests Act, 2005	701.5
<b>Sub-Total</b>			<b>4639.1</b>
Kipini Provisional Forest	214 of 2010	Forests Act, 2005	22,016.4
	208 of 2013	EMCA, 1999	
Lake Kenyatta	208 of 2013	EMCA, 1999	16
<b>Total</b>			<b>26,671.5</b>

Source: KFS 2015

Both Lake Kenyatta and Kipini Provisional Forest (KPF) were declared environmentally significant areas on 29<sup>th</sup> October 2013 under Legal Notice No. 208, pursuant to section 54 of Environmental Management and Coordination Act (EMCA), 1999. Although parts of Kipini Provisional Forest traverse Tana River and Lamu Counties, the Provisional Forest and Witu Forest Reserve are both administered by the Ecosystem Conservator Lamu, with each having its own forest manager. Lake Kenyatta is administered by the Water Resources Management Authority (WRMA) in collaboration with Lake Kenyatta Water Resource Users Association (LAKWA).

## Climate

The ecosystem temperatures range from 23°C to 32°C. High temperatures are experienced from December to April while low temperatures are from May to July. Rainfall is characterized by two rainy seasons with a distinct dry season from January to March. The long rains are from March to August and the short rains are from October to December.

The average annual rainfall at Witu is 1056mm, with 768mm (72%) falling during the long rains and 250mm (24%) during the short rains. The mean annual potential evapotranspiration rate is 2300mm. This means that during the dry season, from January to mid-March, many plants suffer from water stress.

## Edaphic

The land in the region was formed during the Middle Pleistocene (between 2 million to 10,000 years ago) when an extensive coral reef developed on a marine platform. With time, sand dunes were formed between 10,000 to 100,000 years before the present time. Most soils therefore developed from either coral rocks, sediments deposited by the sea and rivers, or from sand dunes. Soil fertility is moderate to low. There are two distinct types of soil; the red loam soils with high clay and silt content, and brown sandy soils with high sand and silica content. Much of WFE consists of sandy soils. Sandy soils are especially prone to depletion of nutrients and loss of fertility if not managed properly.

## Hydrologic

Most rivers within the study area are temporary and several streams like Mukuru drain into Lake Kenyatta. The ecosystem has both permanent and temporary water bodies, most of which are seasonal ox-bow lakes. Lake Kenyatta is permanent while Lakes Amu, Maji Glass, Kangawati, Lumshi, Ziwa camp, Susan camp, Ziwa la Nyati and Ziwa la Mambo Sasa, among others, are temporary. Most adjoining farms use shallow wells for irrigation since the water levels in the sand dunes decrease from about 12m to 0.9m or 1.2m. In addition to sources of water for domestic and agricultural use, these ox-bow lakes are important fisheries for local and immigrant communities.

## DEMOGRAPHY

### Communities around Witu Forest Ecosystem

Communities living adjacent to the Witu Forest Ecosystem (WFE) are primarily pastoralists and agriculturists. The Orma and Pokomo community occupy the western and southwestern side of the WFE; Awer people the northern side, Kikuyu and a mixture of other immigrant communities including the Kisii, Luhya and Luo, the eastern side, and the Sanya, Mijikenda and the Swahili to the west. Other ethnic groups that benefit from the ecosystem include the Somali pastoralist community that occupies the northern part of the ecosystem. According to the 2009 population census, the total population of the community living adjacent to the ecosystem is about 81,231 persons. This is about 80% of the total population of Lamu County. These communities are the custodians of biodiversity in the WFE and an important part of this study was to establish how they are using the biodiversity and implications of the same on conservation.

**Table 2: Household survey of communities in the demonstration site**

Household characteristics	Site			Test		
	Awer (N=30)	Mpeketoni (N=50)	Witu (N=36)	Pearson's chi-square value	f Sig.	Asymp. Sig. level
<b>Household type</b>	(%)	(%)	(%)	13.481		0.096
Male-headed monogamous	66.7	78.0	75.0			•
Male-headed polygamous	10.0	4.0	11.1			
Male-headed single/divorced/widowed	16.7	4.0	0.0			
Female-headed single/divorced/widowed	6.7	14.0	8.3			
Child-headed	0.0	0.0	5.6			
<b>Occupation of household head</b>				4.069		0.131
Farming	86.6	82.0	72.2			
Other	13.4	18.0	27.8			
<b>Occupation of spouse</b>				21.017		0.000
Farming	53.3	100.0	50.0			***
Housewife	13.3	0.0	27.7			
Other	33.4	0.0	22.3			
<b>Education level of household head</b>				32.516	0	0.001
None	33.3	2.0	33.3			***
Primary	46.7	76.0	63.9			
Secondary	13.3	18.0	2.8			
College	6.7	2.0	0.0			
<b>Connection to electricity</b>	30.0	4.0	25.0	11.838		0.019

• Significant at 0.05 confident level, \*\*\* Significant at 0.01 confident level. Source: Linda Mbeyu, 2017

### Average age

Majority of the residents living in the forest are below 35 years (Wiesmann et al 2014). This is an important variable because this is the age group that is most active when it comes to extraction of natural resources for both cultural and economic benefits. This is likely to result in ecosystem degradation through over-extraction leading to negative impacts on the environment. The problem can be addressed by fully engaging this group in the management and conservation of biodiversity plans.

This age bracket requires shelter, food and clothing which they obtain by engaging in some activities that requires the use of resources, including trees, given that there are limited economic activities outside the natural resource base.

### Level of education

The level of education among the indigenous community is fairly low with school drop-outs and low secondary school completion rate being noted. This has been caused by the distribution of schools which are spread far and wide. The prevailing insecurity situation and curfews (early morning and late evenings) make it difficult for youth to move freely (Katana 2016) leading to low uptake of educational opportunities among the local school-age population. However, among the immigrant communities, the number of those who complete their education is higher. There is also a significant (28%) difference between education level indices of men and women in Lamu, placing it at position 38 out of 47 counties in Kenya (Wiesmann et al 2014).

### Households

Majority of households (average 73.2% across the region) are male-headed. Most men have taken up their traditional role of bread winners by engaging in various economic activities. Women and children play an active role in income generating activities, mostly run by community-based organizations (CBOs) around Witu protected area. Most of these are

biodiversity-based enterprises which generate income to supplement household budgets. However, women and children have a lesser decision-making role in resource allocation at household level.

### **Social groups**

There are a number of social groups that communities around the ecosystem belong to. They include self-help groups for men and women, clan groupings, family groupings and ad hoc funeral committees which later become powerful vehicles for community mobilization. What is significant is that despite having a forest that is rich in biodiversity and the Forests Act, 2005, efforts to form a Community Forest Association (CFA) have not been successful thus far, although the process is still underway. The CFA is expected to be a highly-effective tool for engaging the community and government agencies in the management of WFE forests.

## BIODIVERSITY

### The area

Witu forest ecosystem traverses both Lamu and Tana River Counties within the coast region. To the southeast it borders the Indian Ocean, Amu and Bujra ranches to the north, Witu Cooperative Livestock Ranch to the east, Lake Kenyatta settlement scheme and in the west it borders Witu 1 and Witu 2 settlement schemes. This study of biodiversity extended further to the Boni and Dodori forests in the Northern (Mokowe) mainland. There has been historically high land connectivity between the forests on the Kenyan coast and most of the birds and mammal species migrate along the coastal strip. These two taxa are key indicators of ecosystem health in estuarine environments.

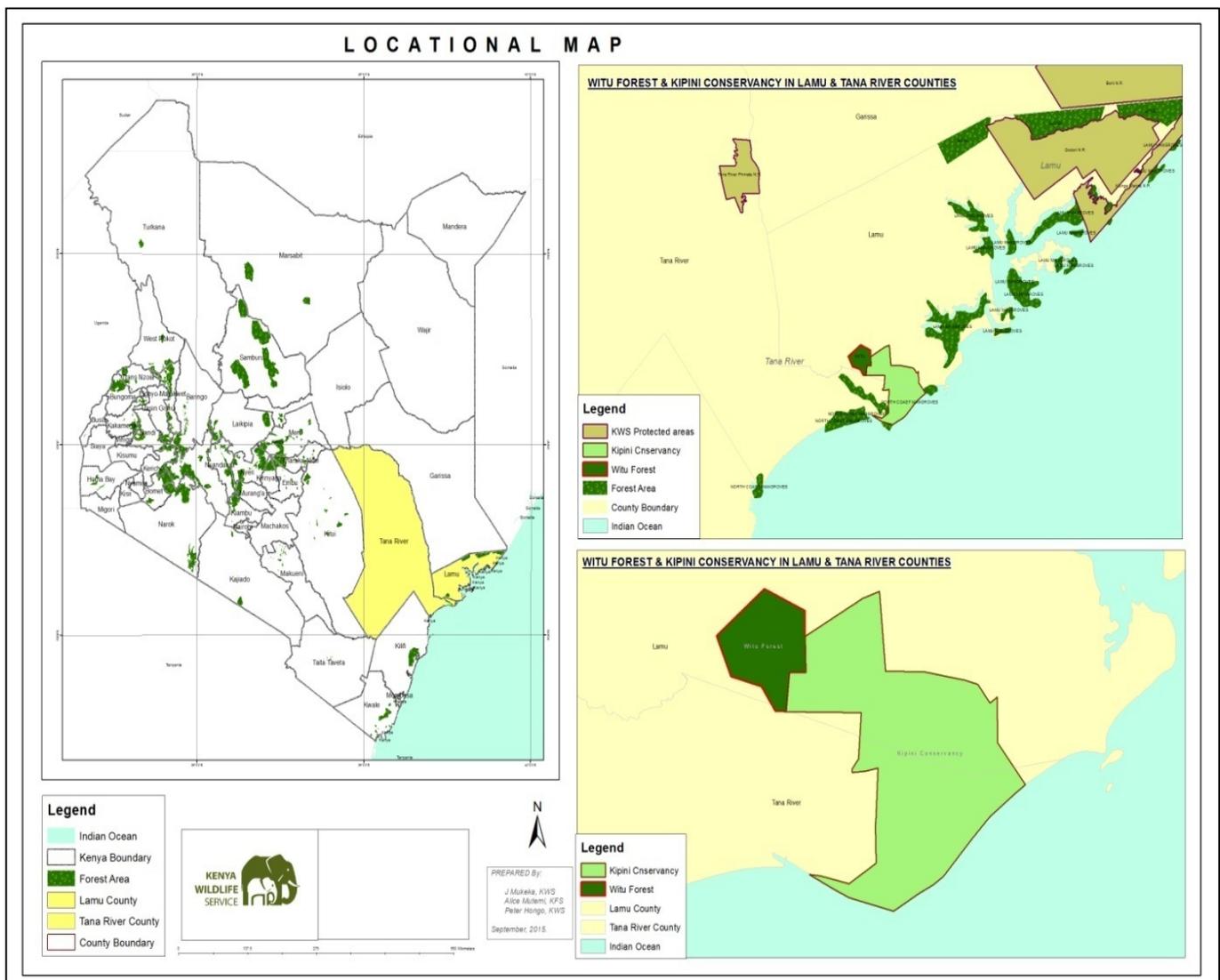


Figure 1: Map of Witu forest ecosystem (Source: KFS 2015)

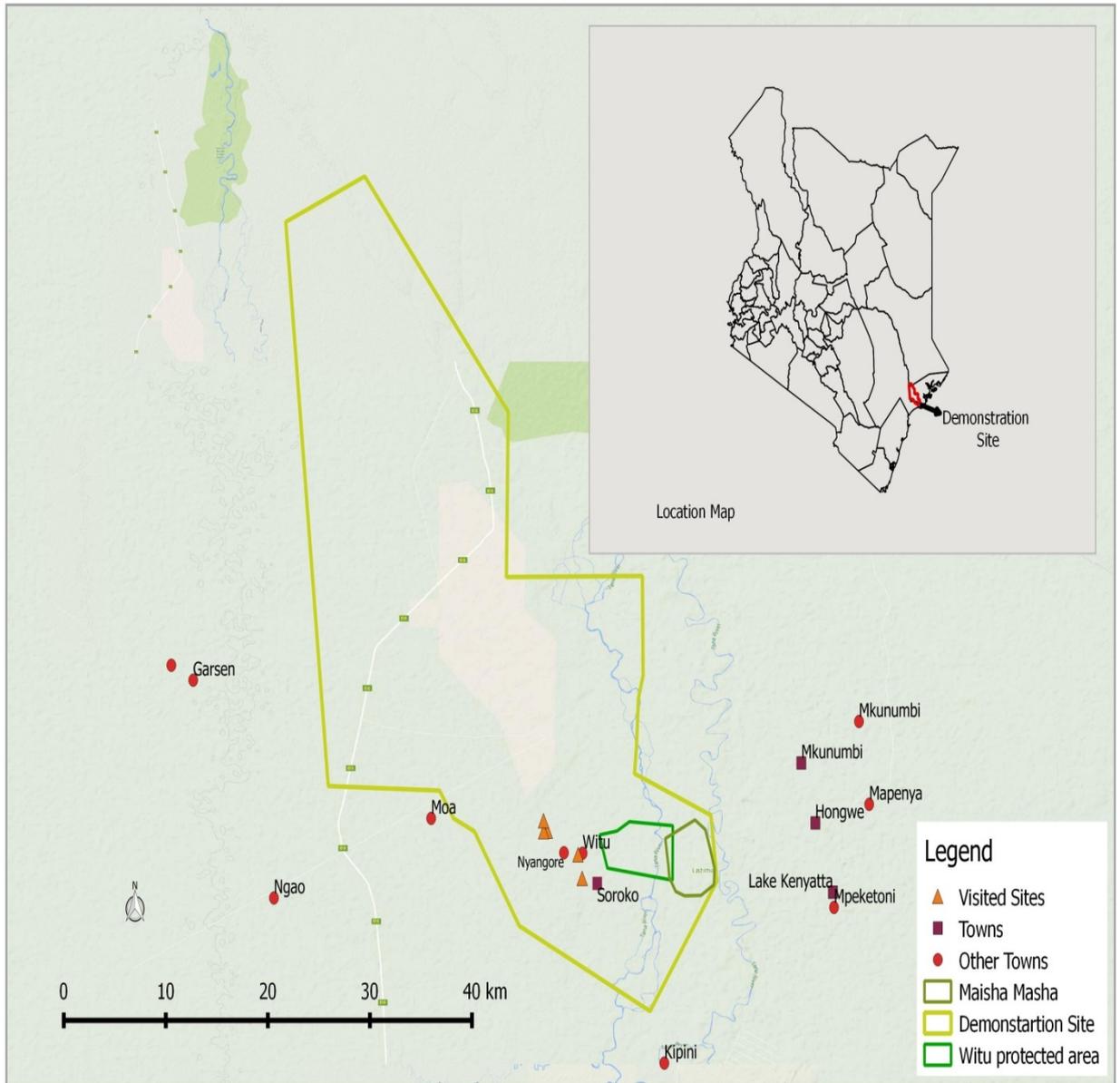


Figure 2: Map indicating the demonstration site in WFE (Source: ICRAF GIS)

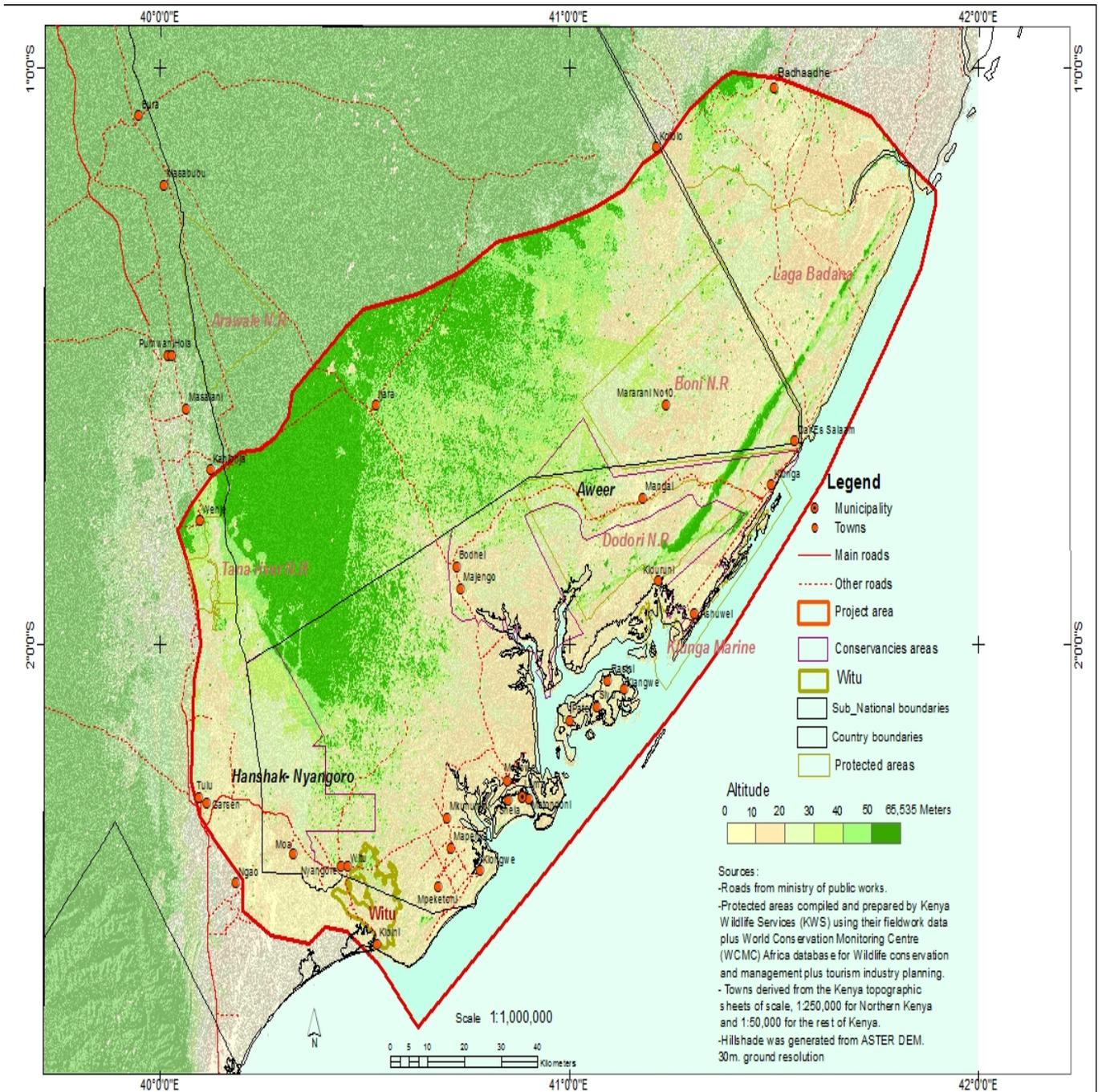


Figure 3: Map of the cross-border area (Source: ICRAF GIS)

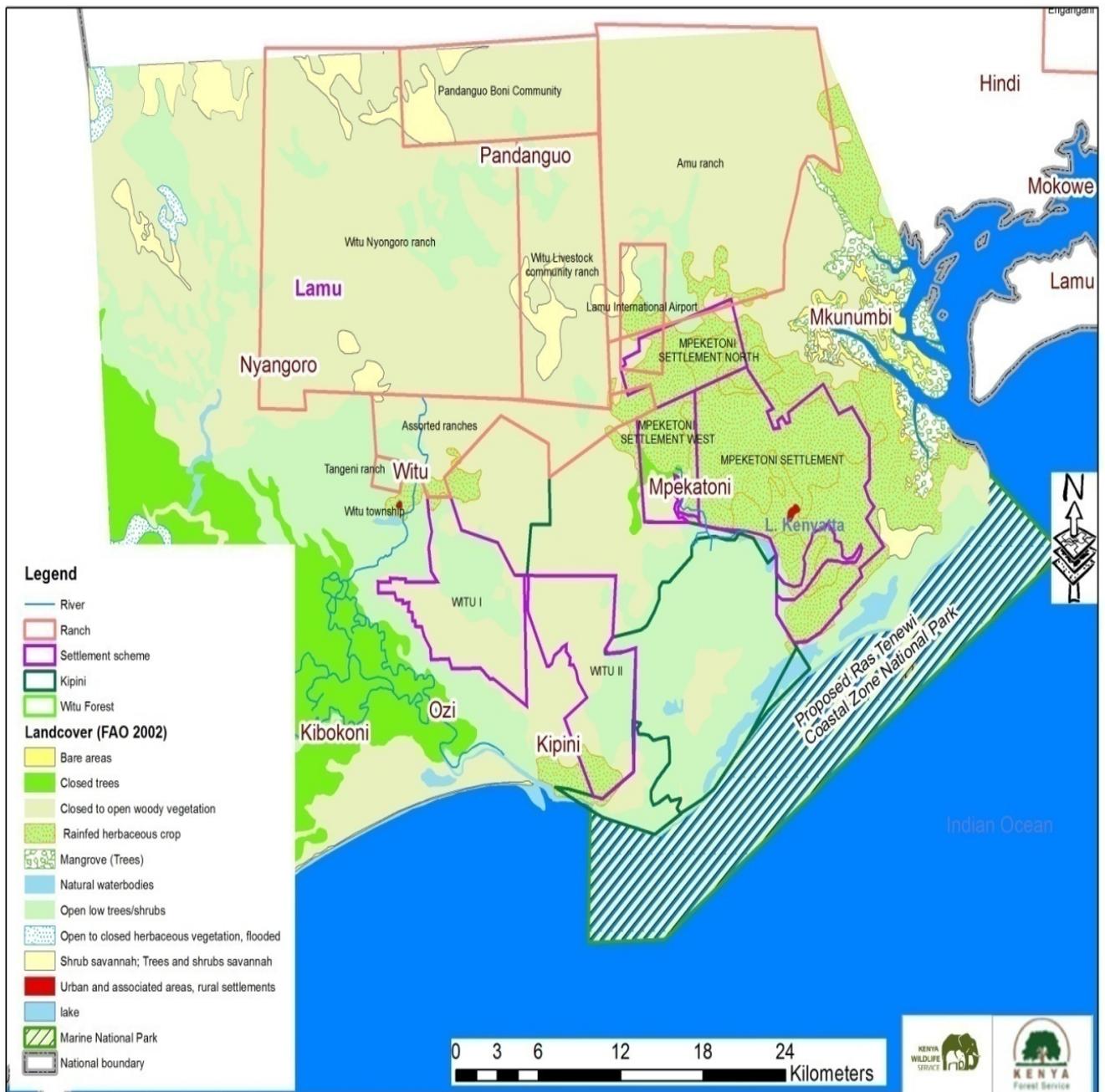


Figure 4: Map showing WFE's neighbouring ranches and settlement schemes (Source: ICRAF)

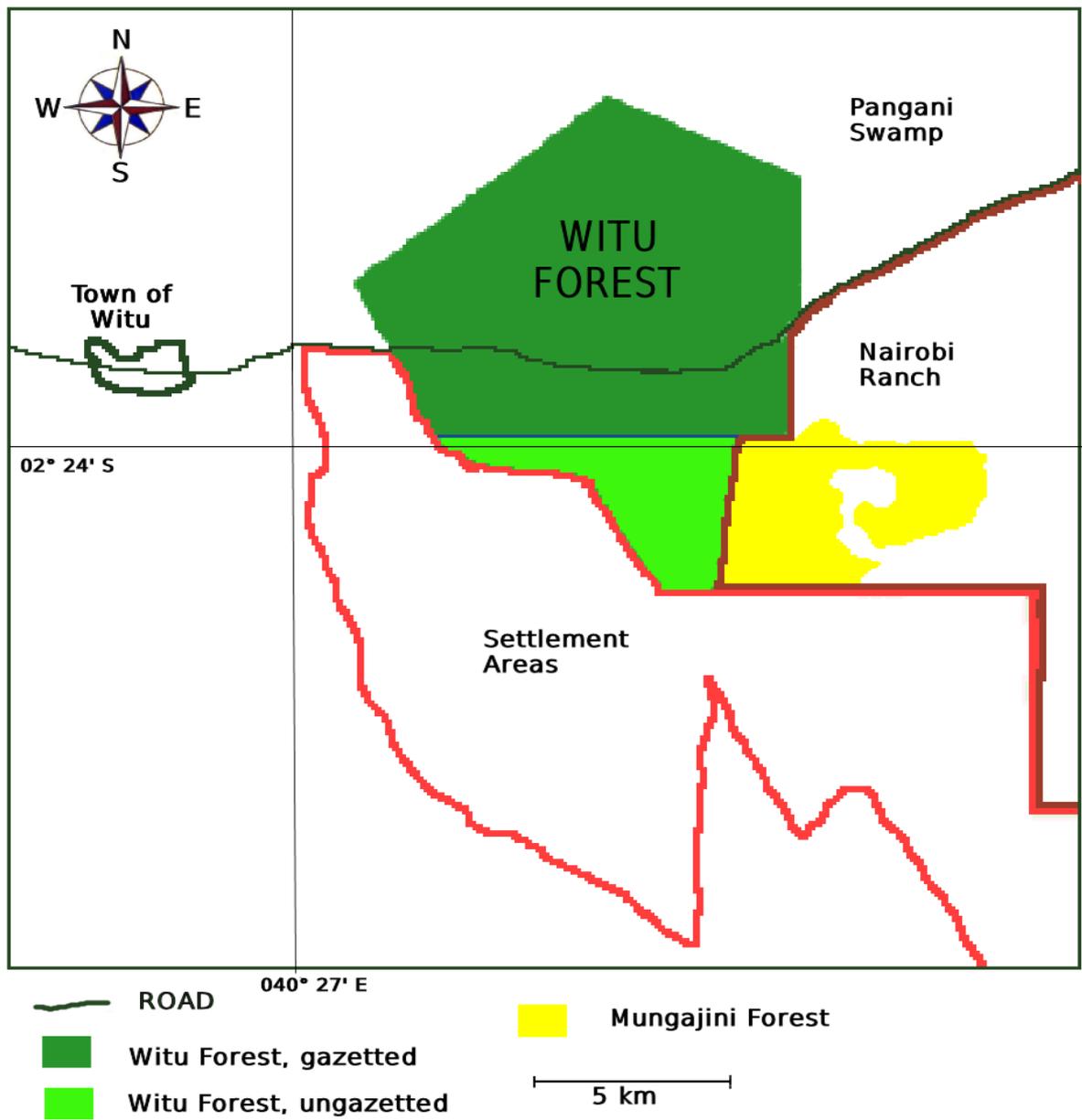


Figure 5: Map showing gazetted and ungazetted parts of WFE (Source: KFS)

## FOREST HABITAT DIVERSITY

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The current wildlife numbers given in Figure 4 are based on an aerial count conducted by Kenya Wildlife Service towards the beginning of the wet season in March 2004 and May 2015. In both cases, total counts of the entire ecosystem were undertaken. The results are considered an underestimate of actual numbers, as many animals could not be seen in the woodland and forest areas due to poor visibility. The dominant woody plants include *Lannea schweinfurthii* (Engl.) Engl., *Oldfieldia somalensis* (Chiov.) Milne-Redh., *Manilkara sulcata* (Engl.) Dubard., *Salacia madagascariensis* (Lam.) DC., *Nectaropetalum kaessneri* Engl., *Uvaria acuminata* Oliv., *Cassipourea euryoides* Alston., *Diospyros spp.*, *Combretum spp.*, *Strychnos spp.*, *Heinsia crinita* (Afzel.) G. Taylor., *Dovyalis sp.*, *Grewia plagiophylla* K. Schum., *Philenoptera bussei* (Harms) Schrire, and *Cassia spp.*, (Kuchar Mwendwa 1982; Quentin Luke, personal communication). Only large wildlife species and livestock which could be sighted from the air were counted in the aerial survey. The more cryptic species were listed from observations made in different research projects and field visits undertaken by various scientists and groups in the study area.

### Floral species diversity

The WFE and other northern Kenya coastal forests lie within the northern part of Zanzibar-Inhambane Coastal Forest Mosaic which consists of a mixture of lowland forests and woodlands, savanna woodlands, bush-land, thickets and edaphic grassland. The eco-region ranges from coastal Somalia to southern Tanzania. Additionally, it has an exceptional level of plant endemism and is considered of outstanding global conservation importance (Burgess et al 2004). Because of increasing human population pressures, fragmentation of natural habitats and because of its biological importance, the eco-region is considered highly threatened. There are numerous endemic species, particularly in forest habitats. There are also close generic relationships with lowland forests in West Africa. The WFE has four major vegetation types which include: coastal dune thicket and scrub, coastal bushland thicket, woodland and wooded grassland, and forest.

**Table 3: Vegetation zones in WFE**

Vegetation type	Area (km <sup>2</sup> )	Characteristics	Ecological importance
Coastal dune thicket and scrub	3	Dense low thicket, no immediate threats, requires further surveys on species composition	Small intact vegetation type, important for protecting coastal dunes from erosion
Coastal bushland thicket	49	Dense medium high, multi-stemmed thickets interspersed with individual tree, extensive wood cutting	Large intact vegetation type, important refuge for large mammals such as elephant, buffalo and lion as well as coastal specialist species such as Suni and Harvey's duiker
Woodland and wooded grassland	128	Mixture of trees and grassland, sometimes forming a closed canopy and interspersed with dense thickets, illegal squatters and farming activities have encroached on woodland	Largest vegetation type, linking up with other vegetation types in the ecosystem, important grazing area for Buffalo, Topi, Waterbuck and Bushbuck
Forest	475	Closed forest but being fragmented by encroachment of illegal squatters and felling of commercial trees in KPF. The forest is still intact in the Witu Forest Reserve (FR)	An extension of Witu FR of 11km <sup>2</sup> is in KPF and therefore it is important for conservation. It is high in species diversity with possible endemics and links to other coastal forests
<b>Total</b>	<b>655</b>		

The distribution of wildlife was related to vegetation type and the presence of water. Elephants were spotted in the northern and western boundaries of the WFE around the Witu Forest Reserve, Mungajini Forest and the corridor, which links Witu Forest Reserve to the rest of the ecosystem. Numerous signs of elephants were also seen in the coastal bushland thickets. Buffalos were spotted mainly in the Siwa grassland and northern wooded savannas, and the bachelor herds in the coastal bush-land thicket. Hippos were concentrated in Lake Kenyatta and the Lumshi swamp. Topi were sighted in the northern sector of the KPF, with local concentrations around Lake Amu and the inland lakes behind the coastal sand dunes. Topi, waterbuck and zebra are common within the ecosystem, around Lake Amu and Lake Kenyatta. There were also concentrations of waterbucks on the south western border of the conservancy and inside the Witu settlement scheme. Zebras were concentrated around Lake Amu and Lake Kenyatta. Oribi were spotted around Lake Amu and Lake Kenyatta (Amin et al 2014).

Lake Amu and Lake Kenyatta are important dry season areas for wildlife. Concentration of wildlife around the two lakes means that they come into conflict with livestock, which are also concentrated around these two important dry season watering points. Lions as well as leopards occur throughout the ecosystem though they are not abundant and not easily sighted. The African wild dog is rare in the area. Of particular importance is the movement of elephants since they come into conflict with human settlements. In the dry season, elephants move south through the northern and western sector of KPF and into the Witu settlement scheme where they home in on Lake Munuji and Lake Kangawati, the only source of water in the western sector during that time of the year.

### Bird diversity

Overall, records and sightings showed 229 species of birds from 61 families in the combined northern coastal forest ecosystems ranging from Kipini to the Boni-Dodori forest complex. Five species are listed as threatened in the International Union for Conservation of Nature (IUCN) Red List. The *White-headed Vulture*, *Lappet-faced Vulture* and *Basra Reed Warbler* are classified as critically endangered, while *Somali Ostrich* and *Martial Eagle* are vulnerable. Six other species classified as near threatened are: *Southern Banded Snake Eagle*, *Bateleur*, *Crowned Eagle*, *Curlew Sandpiper*, *Fischer's Turaco* and *Plain-backed Sunbird*.

Witu forest ecosystem area is part of the East African coastal forests endemic bird area, which ranges from southern Tanzania to the Somali border. There is a total of 30 endemic bird species restricted to this area and 50% (15) of them were recorded in this study area, which forms less than 20% of the total zone. This illustrates its importance as a bird habitat (IBA) and biodiversity hotspot. The species recorded here include: *Southern Banded Snake Eagle*, *Fischer's Turaco* and *Plain-backed Sunbird*. Further, some of the species recorded that qualify the Boni–Dodori forest system as an IBA were nine regionally threatened species: *Somali Ostrich*, *African Darter*, *Great White Egret*, *White-headed Vulture*, *Ayres's Hawk Eagle*, *Martial Eagle*, *Crowned Eagle*, *African Finfoot* and *Little Yellow Flycatcher* (Musina et al 2015).

There were 51 migrant species, and 27 of them were long distance Palaearctic migrants such as *Eurasian Hobby* and *Amur Falcon* whose flocks were observed roosting and feeding

in palm savanna. Out of these, 48 species were water birds occurring along Dodori River and in wetlands near Dodori Creek. This finding indicates that the project is being implemented in an area of global importance as far as conservation of biodiversity is concerned, because its destruction would have an impact on populations of migratory birds from Northern Europe.

Among the terrestrial birds, 83 species were forest birds and 11 were forest specialists, including: *Crowned Eagle*, *African Broadbill*, *Forest Batis*, *Blue-mantled Crested Flycatcher*, *Little Yellow Flycatcher*, *Black-headed Apalis*, *Fischer's Greenbul*, *Tiny Greenbul*, *Red-tailed Ant Thrush*, *Plain-backed Sunbird* and *Olive Sunbird*. Thirty-one (31) were forest generalists, while 41 were forest visitors.

### Biodiversity use and benefits

For a long period of time communities living around WFE have used various resources in the ecosystem to sustain their livelihoods.

#### a) Land for agricultural production

Land ownership within the area falls under different categories of land tenure. Some of the agricultural lands which are mainly small in size are held under freehold (private ownership), whereas ranches are under leasehold. Other types of land tenures include public land and community land. Farming is a major activity, especially around the Lake Kenyatta settlement scheme. Demand for land has led to massive encroachment on WFE. Agriculture is mainly rain-fed and small-scale. WFE is surrounded by several settlement schemes on the eastern and western boundaries of the protected areas. To the west, there is the Witu I and Witu II settlement schemes and in the east there is the Mpeketoni settlement. It is estimated that the area under the settlements is more than 300km<sup>2</sup> and the impact of settlement has fundamentally changed the natural vegetation and migratory patterns of wildlife (DeJong & Butynski 2011). The human population density in some areas is 100 persons/km<sup>2</sup>. Land is mainly used for agricultural enterprises. Maize, cotton, cashew nuts, mangoes and coconuts are the major crops grown. Farm forestry is also practised in the area. The tree mix consists of both indigenous and fast-growing exotic species. Various agroforestry practices have been adopted including tree planting in woodlots, croplands, around homesteads and along farm boundaries especially in Lake Kenyatta settlement scheme. The grasslands support livestock-keeping, especially for pastoral communities.

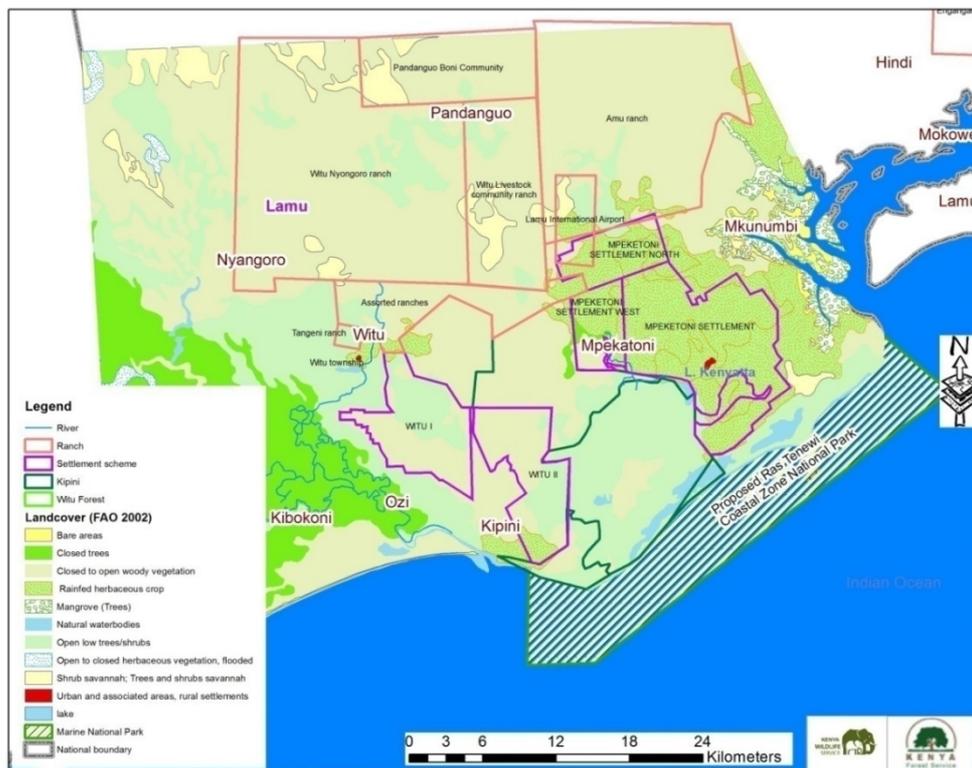


Figure 6: Map showing land use in WFE (Source: ICRAF)

### b) Boat-building

Procurement of wood from Witu and surrounding forests to supply the boat-making industry around Witu forest is fairly lucrative. This is because of its close proximity to the Indian Ocean and Lamu Island, which is a repository of wooden boat-building skills and traditions.

### c) Agroforestry

Agroforestry and farm forestry are also practised within the area, especially around Lake Kenyatta settlement scheme. Trees are planted around homesteads and along farm boundaries. In agroforestry, tree mix consists of both indigenous and exotic tree species but fast-growing species such as silky oak (*Grevillea robusta*), neem (*Azadirachta indica*), whistling pine (*Casuariana equisetifolia*) and blue gum (*Eucalyptus spp*) are dominant. Households adjacent to the ecosystem depend more on forest products compared to those who live further away.

### d) Fishing

Fishing is done commercially on various sites around the ecosystem with a few fish traders targeting the growing market especially the local hotel industry in Lamu, Malindi and

Mombasa townships. Inland water sources, particularly the ox-bow lakes are crucial for freshwater fishery, which is quite distinct from marine fishery in terms of techniques, target species and communities involved.

#### e) Beekeeping

Beekeeping for honey extraction is another activity that is practised in the Witu forest ecosystem, mainly by the older generation, due to the technical skills required. Though they still use the old traditional methods of beekeeping, the community members engage in this activity as a livelihood option. However, ICRAF in collaboration with other stakeholders, has trained various groups on modern beekeeping techniques to enhance sustainable honey production for livelihoods, as well as biodiversity conservation.

#### f) Traditional medicines

Communities in the three areas surveyed (Awer, Orma and Pokomo) revealed that majority of the households use both traditional and modern medicine. Of the three areas, Awer takes the lead in use of traditional medicine (86.7%) followed by Witu (52.8%) then Mpeketoni (30%). Further, in all the three areas, traditional medicine is used more in comparison with modern medicine (Mbeyu 2017).

**Table 4: Proportion of medicines used in Awer, Mpeketoni and Witu**

Ailment	Awer		Mpeketoni		Witu	
	Traditional	Modern	Traditional	Modern	Traditional	Modern
Headache	66.7	33.3	53.8	46.2	25.0	75.0
Tooth ache	50.0	50.0	60.0	40.0	57.1	42.9
Stomach upset	100.0	0	33.3	66.7	100.0	0
Sprains	-	-	-	-	100	-
Eye problems	100.0	0.0	100.0	0.0	100.0	0.0
Teething in children	100.0	0.0	-	-	0.0	100.0
Body ache	100.0	0.0	33.3	66.7	0.0	100.0
Ear ache	-	-	-	-	-	-
Animal sting/bite	-	-	100.0	-	-	-
Skin	100.0	-	-	-	100.0	-
<b>Average</b>	<b>88.1</b>	<b>41.65</b>	<b>63.4</b>	<b>54.9</b>	<b>80.35</b>	<b>79.48</b>

Source: Linda Mbeyu, 2015

In all the three communities interviewed, Mbeyu (2015) found that a myriad of ailments scored 100%, meaning that the communities only use traditional medicine for these ailments. The reason for this finding could be that they do not know the name of the modern medicine used or these are minor problems which can be treated at home using traditional herbs. A key informant indicated that the medicinal herbs included: neem tree (*Azadirachta indica*) for treating malaria, *Mnyondo* tree for relieving body pain, *Muthithi* tree (*Mayterus Senegalensis*) for treating skin diseases, and the bark of a cedar tree which is used to treat liver infection.

#### g) Construction and furniture making



Natural materials used for roofing, fencing and putting up walls in Didewaride, Witu. Photo©Mordecai Ogada, 2015

Data generated from the 2015 study by Linda Mbeyu indicates that communities in the three areas depend on nature for construction materials. While there are differences in the materials used for roofing homes, there is a lot of similarity on materials used for the floor and walls. Majority of households in Awer and Witu build houses using natural products, i.e., grass thatch (60%) and palm leaves (55.6%) respectively for roofing. The demand for wood extracted from WFE is also driven by the furniture-making industry. The demand for furniture, especially made from hard wood, has prompted people living around the Witu ecosystem to cut trees. These furniture items including beds, chairs and tables, are commonly sold in markets and by the roadside in the Witu forest area. The furniture trade and industry is a major economic activity extending further north into Lamu.

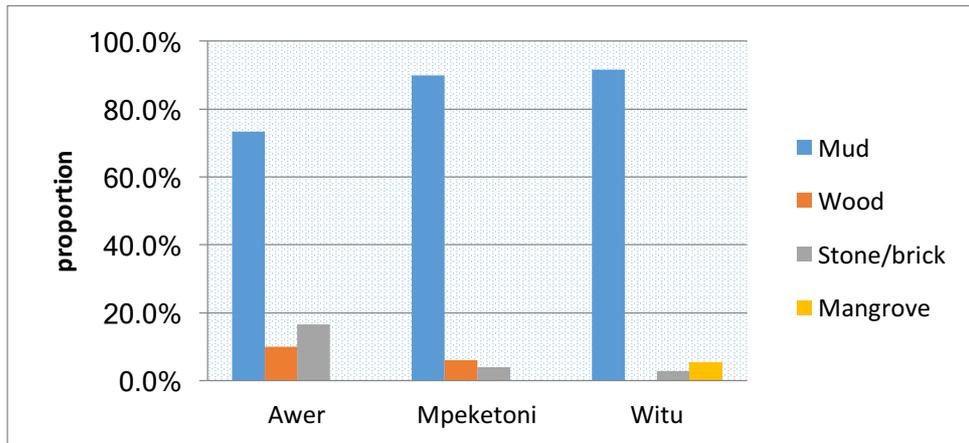


Figure 7: Proportions of construction materials used in the study area (Source: Linda Mbeyu, 2015)



Ornamental door and dugout canoe in Lamu

### Threats to biodiversity

Over the years, the Witu Forest Ecosystem and other forests of the northern Kenya coastal regions have experienced serious environmental threats and constraints directly caused by human activities (in situ) and indirectly through global-level environmental impacts (ex situ).

The effects of climate change are detectable in these coastal forests and are exacerbated by more direct human impacts. An example is rising sea levels that have resulted in seawater incursion up the Tana River delta. This has been worsened by the increased impoundment and abstraction of water in the catchment areas, reducing the volume of water flowing to the delta. Increased salinity of soils in the delta has also resulted in die-offs of less salt-tolerant species. Invasive species, particularly *Prosopis juliflora* are also a significant problem in the northern coast of Kenya, and their spread is accelerated by the unsustainable harvesting and browsing pressure on indigenous species due to overstocking. Direct *in situ* impacts include the following:

**a) Illegal and unsustainable harvesting of trees**

This is mainly done by local craftsmen, who harvest trees for furniture making. Lamu's local furniture, doors and chest of drawers have been in demand over the years due to their unique look since the days of the Sultans. This demand has forced many craftsmen to target mainly hardwoods like *Azelia quanzensis* and *Manilkara sansibarensis*, as well various mangrove species, to the point where some tree species are facing extinction. This threat, like most which are driven by elite luxury demands remains largely unacknowledged relative to those driven by poverty, for instance charcoal burning. Targeting old hardwood trees has a greater impact on endemic old-growth dependent species like the Arabuko-Sokoke scops owl (*Otus irenae*) (Zimmerman et al 1996). It also has a negative effect on mammals that are dependent on larger trees, like the straw-coloured fruit bat (*Eidolon helvum*) and various primates. Illegal harvesting of trees is also driven by the use of wood fuel amongst local communities for cooking. This may be a more acute threat to the forests because of the apparent lack of alternatives, or unwillingness of the communities to seek alternatives.

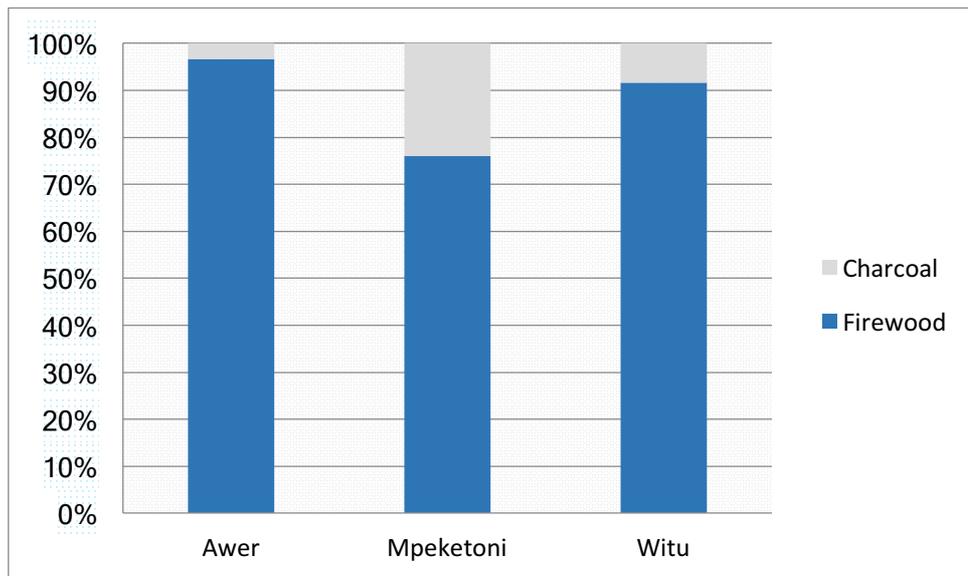


Figure 8: Proportions of cooking fuel used in the study area (Source: Linda Mbeyu, 2015)

Data from the 2009 Kenya Population and Housing census indicates that more than 90% of households in the study area depend on wood fuel for cooking (Mbeyu, 2017). All the three areas primarily use firewood as the source of cooking energy largely due to the perception that it is easily and locally available. Most northern Kenya coastal forests, the Witu and Boni-Dodori forest systems suffer habitat modification from poaching of valuable trees such as *Brachylaena huillensis* and *Combretum schumannii* which are preferred for the carving industry and construction further south (Bennun & Njoroge 1999). Selective logging of timber and poles continues to be a major problem. Regeneration of some of the logged-over forests has been hindered by repeated slash and burn by the Awer community who since their enforced resettlement and the hunting ban, are significantly more dependent on agriculture for subsistence, and to a limited extent for cash, although the lack of a ready market means that they have to rely on passing trade and hence lower prices (Morris et al 2011; WWF 2010). In addition, new settlers from other parts of Kenya are coming in and clearing large tracts of land for cultivation along the Hindi-Bodhei Junction, west of Lungi Forest. Unlike other coastal forests the area is still sparsely populated due, in part, to insecurity. This had a negative impact on agriculture near the villages dotted along the Hindi-Kiunga road. Intense slash and burn agriculture by new settlers is also prevalent on the outskirts of Witu Forest and on Manda Island.

#### **b) Quarrying**

This is a major driver of habitat destruction, particularly on Manda Island, which is the only source of coral blocks, used for construction of houses in and around Lamu. With the planned infrastructure developments around the LAPSET project, demand for housing is expected to increase sharply. This will have a negative impact on the areas where quarrying is done. The damage from quarrying coral blocks is exacerbated by harvesting of trees for wood fuel, which are used to manufacture white lime plaster by baking coral rocks.

#### **c) Overgrazing**

This has been a major problem in WFE because the forest is very rich in fodder thus attracting pastoralist from neighbouring counties and from Somalia. This has resulted to conflict for the scarce resource especially during dry seasons.

#### **d) Fires**

This has been a rampant problem and poses a serious threat to the forest, particularly in the dry season. Fires are mostly caused by honey harvesters who forget to put out their fires after harvesting. These fires normally get out of hand as they spread quickly and cause a lot of damage to trees. ICRAF, in collaboration with other stakeholders, has embarked on training communities on modern apiculture techniques which are safer for the forest. As this training is scaled-up, the threat is expected to diminish.

#### **e) Inadequate resource management**

This is a problem mainly facing organizations responsible for management of the forest. These include KFS who don't have the necessary equipment, including motorbikes which can easily traverse the forest and help in monitoring as well as capacity building of the forest managers and the local communities through training and awareness creation. KFS could also benefit from the provision of boats, which can be used to monitor activities and movement of forest products amongst different islands in the Lamu archipelago.

#### **f) Poaching**

Though not on a large scale, poaching is a threat to WFE. Poachers, mainly comprise the indigenous community living around the forest who collect food and for cultural practices. It was difficult to establish the extent due to the illegality of the activity. In Mpeketoni, respondents revealed that wild animals are slaughtered and sold at night, because it is an illegal practice. The wild species consumed include buffalo, hippo, Topi and antelopes.

#### **g) Human-wildlife conflict**

This, like in many other forests, is a threat to WFE. Witu Forest is a migration corridor for wild animals, who interfere with farms in the villages and as a result, end up being injured or killed by villagers. Crop raiding by primate species and elephants are a major challenge to agriculture and food security in the area.

#### **h) Insecurity**

Recently in Lamu the threat of terrorism has hindered the management and full utilization of WFE. It is still a heavily-militarized area, and this makes most livelihood activities difficult. This situation also poses a challenge to biodiversity conservation work, including field research and engagement with communities. These challenges were also encountered in the course of this particular project.

#### **i) Ethnic conflict**

This has also been a major hindrance to natural resource management initiatives in Witu Forest. These conflicts mainly occur between pastoralists and farmers, and are based on the rights to, or utilization of various natural resources in the area. Though elders in the Witu areas have convened *barazas* which try to solve these conflicts, it has proven to be a major problem, because the new constitution of Kenya has mandated the engagement of communities in the management of natural resources, particularly water and forest resources, through formation of Water Resource Users Associations (WRUAs) and CFAs, respectively.

#### **j) Land tenure issues**

Land tenure is one of the most complex problems facing WFE. Those most affected include locals and outsiders (people who don't live around the ecosystem) who own ranches which are part of the ecosystem. The locals claim that some ranches are non-existent, whereas others are registered under locals but belong to outsiders. This is underscored by a large proportion of immigrants who move to the area specifically to exploit natural resources and employment opportunities. This problem has greatly affected utilization of Witu Forest. Lack of secure tenure makes it difficult to engage them in conservation and responsible use of natural resources.

**Table 5: Number of immigrants and primary reason for moving into the area**

	<b>Awer</b>	<b>Mpeketoni</b>	<b>Witu</b>
Number of immigrants	1	48	29
Employment	100%	-	-
Land and natural resources available	-	100%	96.4%
Other reasons	-	-	3.6%

Source: Linda Mbeyu, 2015

Other threats include human encroachment, the impact of climate change, lack of roads and tracks, external interference (from politicians, tribesmen and pastoralists), inadequate community support (no CFA) and unsustainable extraction/utilization of forest products.

## OPPORTUNITIES

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Communities living around WFE and surrounding forest areas in the north coast have various opportunities in which they can use the ecosystem sustainably to cater to their various needs. These are discussed below.

### Tourism

WFE has attractive sceneries and a great potential for tourism development, which is yet to be fully harnessed. The ecosystem is endowed with unique cultural and historical sites that are of great tourism attraction. In addition to this, there is a diversity of wildlife population which includes elephants, buffalos, reptiles and birds, which attract visitors. The ecosystem has potential to support tourism by offering a diversity of activities such as bird watching, fishing, walking and wilderness trails. The development of tourism facilities around the ecosystem would promote employment, both directly and indirectly, through the flow of demand for goods and services. Local communities would also obtain gainful employment from tourism as tour guides and as they trade in agricultural products in hotels in nearby towns and other urban centres. Tourism has however, been greatly hindered by insecurity in the area.



Straw-coloured fruit bat (*Eidolon helvum*) in Witu forest. Photo©Mordecai Ogada, 2015

## Food production

The people of Witu, if trained appropriately can maximize on food production by being engaged in the Plantation Establishment and Livelihood Improvement System (PELIS) (*shamba*) system practised in several gazetted (KFS-managed) forests in Kenya. This includes planting appropriate crops for the soil found in that area and by using correct farming methods. On the same farming model, the local community would also practise reforestation by incorporating various types of trees on their farms. This will help rejuvenate the forest. Farmers can also plant and plan proper use of fodder so as to try and curb the problem of overgrazing.

## Water harvesting

Communities living around Witu Forest can also harvest a lot of water from the ecosystem. If trained on how to conserve and use the forest sustainably, water bodies around the ecosystem will not dry up, hence ensuring that water is readily available to communities around the forest. It is also important that structures are created to allow use of water resources without damaging the sources. These include compliant water intakes and livestock drinking troughs. Improved availability of water in locations away from the forest will also result in reduced incursion of communities into riparian areas. ICRAF has initiated a water harvesting project targeting communities around Witu Forest in a bid to sensitize, train and impart skills and knowledge.

## Beekeeping

This is a valuable opportunity through which local people living around Witu can supplement their livelihoods. The community is already involved in beekeeping, on a small scale. Farmers who keep bees still use traditional methods could be because they have not been exposed to other technologies. This pose a threat to the forest due to constant felling of trees to provide the hollowed out logs, used for hives and the occurrence of accidental fires. Many villagers harvest honey at night using fire torches, which sometimes burn out of control. ICRAF has trained various groups around Witu Forest on modern apiculture. The groups have been supported by modern equipment including modern hives, honey extractors and harvesting kits. If this apiculture training programme can be scaled up, environmental and economic gains from this activity could be maximized across the entire

project area. Agriculture Sector Development Support Programme (ASDSP), which is a sector under the government of Kenya has potential to support beekeeping activities in WFE but that is yet to be fully achieved.



Coral block quarrying in Manda Island. Photo©Mordecai Ogada, 2015

### Formation of a community forest association

The community around Witu Forest has not yet formed a community forest association (CFA). This is attributed to many obstacles including insecurity and tribal conflicts. However, once formed, the communities will better manage and utilize the forest. Such an association will help in planning various economic and conservation activities that will help both them and the forest. Through the CFA, locals can market their produce to potential customers, start a nursery, market their furniture, and seek for funds to initiate various activities like borehole drilling, write a management plan for the forest and other beneficial activities. Discussions are currently underway between KFS and the community on the formation of a CFA and the drafting of a constitution for the same (Patricia Maina- Forest Manager, KFS, personal communication).

## POSSIBILITIES FOR ACTION

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This study found that several actions can be taken to ensure that Witu Forest and other forest ecosystems in the northern Kenya coastal regions are not depleted.

### Formation of a Community Forest Association

With the formation of a CFA, communities living around the ecosystem can manage their activities sustainably; like farming, sustainable extraction of forest products, conservation and other economic activities. This is because the CFA will have a management plan which will clearly outline how to utilize the forest sustainably. The association will also bring communities together and curb the problem of tribal conflicts. In addition, communities will have trained scouts who will help manage the forest. Communities will also be in a position to undertake their economic activities in a sustainable and organized manner. These include collection of medicinal plants, firewood, grazing of livestock and quarrying. In addition to CFA, Community-Based Natural Resource Management (CBNRM) associations could also be formed to manage freshwater resources and fisheries. These will bridge the gap left by resource limitations or absence of state agencies.



Slash and burn agriculture in Manda Island. Photo©Mordecai Ogada, 2015

### Equipping KFS and other partners involved in forest conservation

This will promote effective management of the forest and sensitization of the community on conservation issues. Many organizations, like KFS, are unable to access the heart of the forest where illegal activities may be occurring. They also have a hard time tracking illegal logging due to lack of equipment. Vehicles are very few, they don't have enough motorcycles and the manpower to effectively carry out their activities in and around the forest. Some of the forest areas (including mangrove forests) within the Lamu archipelago are more accessible by sea, hence KFS would benefit from being equipped with boats for more effective patrols.

### Communication of progress

These are activities that were initiated to help the ecosystem and communities around it. When interviewed, community members expressed the opinion that many conservation activities have been initiated, but have but have been faced with various challenges. This is due to lack of knowledge of what is going on. The BMP project would therefore benefit from a continuation of the investment currently being made in communication and community engagement.

### Sensitization of the local communities

This is an ongoing activity being undertaken by ICRAF and the statutory partners (KWS and KFS), and upscaling it will greatly help the local villagers understand the impact of activities like overgrazing and illegal logging on biodiversity. The expansion of agroforestry activities will equip local communities with skills and knowledge to use the forest in a sustainable manner. Much progress has been made thus far, but ethnic conflict and general insecurity in WFE.

### Upscaling agroforestry

Some tree species, e.g. Mpingo (*Dalbergia melanoxylon*), are facing extinction in Witu and other coastal forests due to unsustainable harvesting and use. To counter this, ICRAF in conjunction with Kenya Forestry Research Institute (KEFRI) have come up with a fast growing substitute for the original indigenous species. If this substitute can be distributed to local communities and made into a major agroforestry 'crop', expansion of this initiative

would generate establishment of agroforestry seedling systems which in the long run will significantly reduce pressure on natural forests.

### **Solving the human-wildlife conflict**

Educating local communities on the origins of human wildlife conflict would help them understand how to prevent and control this problem. Human-wildlife conflict has led to losses, both on the communities and wildlife, because animals destroy their farms and in turn villagers kill these animals. Educating and curbing human encroachment on wildlife migration corridors is one of the actions that may help mitigate this problem. In this regard, ICRAF and KWS recently partnered to sensitize partners and raise awareness among local community members on opportunities for community-based biodiversity conservation potential offered by the recent Wildlife Conservation and Management Act (WCMA 2013).

### **Ensuring there is adequate security**

The Kenya Defence Forces (KDF) and local police are doing their best to ensure that the areas within and around WFE are safe. This has helped communities continue with their day-to-day activities, but more needs to be done regarding their own internal insecurities. This includes tribal and periodic resource conflicts between pastoralists and farming communities. If these problems are adequately addressed by relevant authorities, it will pave way for more effective conservation efforts.

### **Management of access**

Infrastructure development such as LAPSSET, will open up access to Witu Forest. This could potentially relieve pressure on the ecosystem due to ease of transportation of timber and non-timber products. Second, there could be adverse effects of pollution from shipping, diesel locomotives, and the Lamu coal power plant. This could be mitigated by close monitoring of land vehicles and implementation of a vessel monitoring system (VMS) to monitor maritime traffic in partnership with the Marine Research Institute in Somalia. From the community/terrestrial conservation perspective, this entire area is used by pastoralists from as far as Somalia, particularly in times of drought and other difficulties. It would be important therefore, for conservation plans to include Effective management of the resource to ensure sustainability.

## Education of resource users

Integrating the IGAD Environment Education in Training (EET) programme into respective Kenyan and Somalia national educational curricula will enhance the capacity of resource users to sustainably manage the resources. Locally, ICRAF in collaboration with KFS and other stakeholders, should invest in education of boat builders, and furniture makers on latest technologies that can be applied in order to use wood in the most efficient manner and avoid waste. Other areas of emphasis should be recycling. Wood from wrecked boats can be recycled and re-purposed into furniture or boats, amongst other purposes like wood fuel.

## CONCLUSION AND RECOMMENDATIONS

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This study found that the cross-border area of north-eastern Kenya and southern Somalia is a biodiversity hotspot of global importance, but faced with a myriad of immediate challenges. Based on the observations of this biodiversity survey, the IGAD BMP project is timely and urgently requires biodiversity conservation action involving the local community and statutory conservation bodies such as KWS and KFS. Being a relatively underdeveloped part of Kenya, there is still heavy dependence on ecosystem goods and services. The heaviest use of ecosystems was extraction of wood, driven by its use for furniture, construction, dhow-building, and dugout canoes. The construction industry is also a major driver of fuel demand, since the product is used in baking coral rock to obtain 'white cement' (lime plaster), the most widely used construction matrix in Lamu. The entire area is inhabited by communities who are heavily dependent on ecosystem products and services for their livelihoods and urgently need capacity building to pursue these livelihoods in an environmentally sustainable manner.

Some of this dependence on ecosystem services has a direct impact on biodiversity, for instance, the loss of forest cover due to logging of forests for wood and wood fuel. There are also some indirect effects of these activities like the loss of habitat for specialist species. An example of this is the loss of large trees, which constitute crucial habitat for the straw-coloured fruit bat, a species that is considered near-endangered (Patterson & Webala 2012). A species could therefore be threatened or lost without being directly targeted. This conclusion can be drawn from a combination of different factors:

- a) Low level of infrastructure development and high dependence of the population on ecosystem resources.
- b) Target 'growth area' for major infrastructure development project (LAPSSET) (Kanyakine 2012).
- c) Establishment of a coal-fired power plant that may boost economic development in the area, but also have a harmful effect on the natural environment.
- d) Past incidents on insecurity leading to a near state of emergency in the area that curtails agricultural and commercial activity, exacerbating the already high poverty levels.

- e) Establishment of wildlife conservancies driven by Northern Rangeland Trust (NRT) in the area which may curtail the communities' use of natural resource (e.g. grazing) and impact their livelihoods (particularly the pastoralist communities).

All the above factors point to a period of very rapid economic, social and environmental transition. The greatest challenge is that they are all occurring at the 'macro' scale and local communities and their livelihoods may be left out. A relatively young (< 35 years old) rural population that is possibly disenfranchised rapidly turns to environmentally unsustainable practices like illegal logging, charcoal burning, or poaching to supplement their livelihoods. This in turn, would have a devastating effect on the biodiversity in the area, which includes several endemic and bird species which are Palearctic migrants.

This study also concludes that the IGAD BMP project is well placed to exert a significant impact on the management of natural resources and conservation of biodiversity in the entire cross-border area of north-eastern Kenya and southern Somalia extending from Tana River in Kenya to the Lag Dera/Lag Badana in Somalia. It is a platform that includes civil society, government agencies and communities from both countries, hence presents the best opportunity for genuine inclusion of communities in discussions around environmental conservation and development.

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