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## **Landscape Profile: Kilwa**

**Document prepared as an input to the GEF PPG  
process to develop a full sized proposal for the  
Tanzanian Coastal Forests**

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Coral rag forest  
in Uchungwa Forest

## **1) Introduction**

This report provides the detailed findings of a review of the literature about the Kilwa landscape together with the results of a field visit to Uchungwa forest (near Migeregere Village on the Mbarawala escarpment) and Pindirol Village Land forest by a team from the Tanzania Forest Conservation Group. The report has also incorporated data from a report prepared by the botanical expert Phil Clarke. The report aims to support a project proposal to GEF / UNDP for investment in the conservation of Tanzania's Coastal Forests. The Kilwa landscape is one of three landscapes that has been prioritised for investment due to its global economic values.

## **2) Description of the physical landscape and climate**

### Topography

The Kilwa landscape is in south-east Tanzania. The Landscape is dominated by two elongated plateaus running parallel to the coast some 40 km and 60 km inland between the Matumbi Hills to the north and the wide Mbemkuru valley to the south. The western (inland) of these is known as the Mbarawala Plateau while the Ruwawa Plateau is located towards the coast. Both plateau systems are interrupted at their northern end by the Mavuji River, giving rise to the spectacular and little known forested Rudadonga gorge with sheer 100 m sides of ancient coral-rag limestone. Coastal Forest is mainly found on these plateaus but is also present along a large length of the Mavuji River.

The landscape lies in Kilwa District, Lindi Region.

In terms of soils, the lowland areas have deep, leached sandy soils derived from terrestrial sands, gravels, calcretes and laterites of Miocene to Pleistocene age. The escarpments have a mixture of ancient coral rag and sandy loam and clay soils.

Small patches of forest are located on and around these plateaus, as well as along the Mavuji River and near the coast. The northerly extension of the Mbarawala plateau is an area of hills around Uchungwa peak. These hills have extensive areas of ungazetted forest and woodland.

The altitude of the landscape ranges from 15 m to 480 m, the highest points are on the Ruwawa Plateau within Ngarama North Forest reserve and in the South within Pindirol Forest Reserve. In the North, the Mbarawala plateau extends up to 404 m at Uchungwa Peak whilst the highest point in Mitundumbea is 420 m. To the west the land drops down to a lowland plain at around 120 m whilst to the East the land drops rapidly down to the coastal plain at 10 - 15 m.

### Hydrology

The main rivers that flow from the Kilwa landscape rise both from areas west of the main Ruwawa and Mbarawala plateaus as well as from the bases of these plateaus. The main rivers include the Kihimbwi which drains the Eastern side of Ngarama; the Mbemkuru which drains the southern areas including Pindirol to the South of Ngarama and the Mavuji river which drains the northern end, with numerous seasonal water courses and some small wetlands including the Pindirol hippo pool. Depending on where the boundary of the landscape is located, the Matandu river to the north is also an important river flowing through Kilwa District.

The Pindirol River, a tributary of the Mbemkuru flows between the two plateaus in the south.

Orographic precipitation (rain and mist) causes rainfall to be highest on the plateaus. However this water quickly drains away through the free draining sandy to limestone geology re-emerging to form rivers and small lakes in valleys on the edge and at the bases of the plateaus. As a result, settlements and agriculture are based in the valleys and at the base of the plateaus. This has contributed significantly to conserving the plateau top forests.

## **3) Biological values**

### Individual forest descriptions and habitat types

Prins and Clarke (2006) summarise the landscape as follows: 'In Kilwa District it is still possible to observe a distinct series of vegetation bands running parallel with the coast. Progressing from inland towards the coast, we were able to observe a general trend towards increasing vegetation density, going from open woodland (mainly miombo), to denser miombo, *Brachystegia* forest (sensu Clarke 2000), scrub forest and then Coastal Forest on the series of hills that run along the coast.

These hills, which are situated approximately 30 km inland of the coast, form a discontinuous chain in SE Tanzania (Clarke 2001). The moister seaward side of these hills, together with the littoral plain (which contains the main Dar es Salaam-Lindi road), are now too heavily modified by human activity to detect any recurring patterns in natural vegetation.

Some of the vegetation types found within the landscape include: scrub forest, dry evergreen forest, *Brachystegia* woodland, riverine forest, wooded grassland and coastal thicket. The Ruwawa (including Ngarama N & S and Mitundumbea FRs) and Mbarawala (including Pindiuro FR) plateaus contain the bulk of the coastal forests. On the westerly landscape boundary is Rungo FR and the east is delineated by Ngarama North FR and Ngarama South FR, Mitundumbea FR and Uchungwa, an area of ungazetted forest. To the east of the plateaus on the coastal plain there are areas of coastal thicket and dry forest as well as woodlands. Miombo woodland is present outside of forest areas in all the reserves.

#### Ruwawa plateau

Ngarama North and South FRs and Mitundumbea protect parts of the Ruwawa plateau. This area is characterised by an eastward facing escarpment formed by sea level changes and uplift processes. This results in variable vegetation patterns over the plateau in part caused by rainfall variations which tend to be higher on the escarpments. The plateau itself is in many parts ancient coral rag limestone which

results in free draining dry conditions and the formation of caves provide habitats for rock and cave dwelling animals. Most of the Ruwawa

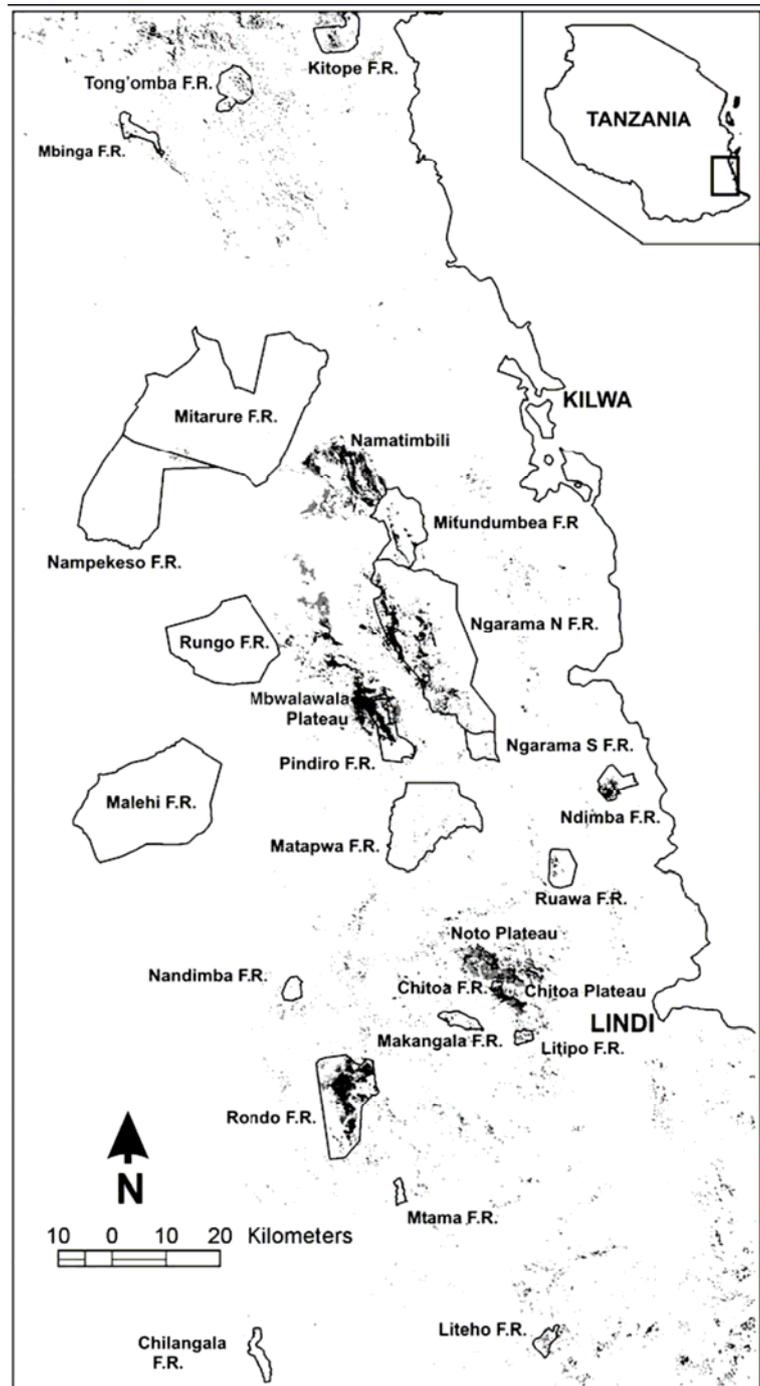


Fig. 1 Distribution of Swahilian Coastal Forest and Forest Reserves in Lindi region, Tanzania. Closed forest in black and scrub forest in grey From Prins and Clarke 2006.

Plateau is covered with different types of scrub forest although many patches of Coastal Forest still occur on the plateau especially to the NW along ridges, including a formerly undescribed area of ca. 5 km<sup>2</sup> of well-developed mixed dry forest and legume dominated forest in the north western part of Ngarama North FR (Prins and Clarke 2006).

UTUMI (2002) estimated that there is 42 km<sup>2</sup> of scrub forest and ca. 13 km<sup>2</sup> of mixed dry forest on the plateau. Most of the scrub forest is dominated by *Grewia* sp., *Hymenocardia ulmoides*, *Cussonia zimmermannii*, *Bombax rhodognaphalon* and *Vitex schliebenii*. A tiny patch of forest with *Hymenaea*

*verrucosa*, *Scorodophloeus fischerii*, *Strychnos henningsii* and *Synaptolepis kirkii* is located outside the main forest block (Clarke 1995). The lower parts of the reserve are dominated by woodland.

The vegetation of the **Ngarama South FR** varies from open to dense woodland to scrub forest with *Milicia excelsa*, *Markhamia obtusifolia* and *Pteleopsis myrtifolia* (Clarke 1995). There is not much forest left in Ngarama South Forest Reserve (Eriksen *et al.* 1994) except a small remnant patch of forest occurring in the eastern edge with 25 m high canopy dominated by *Hymenaea verrucosa* (Clarke 1995).

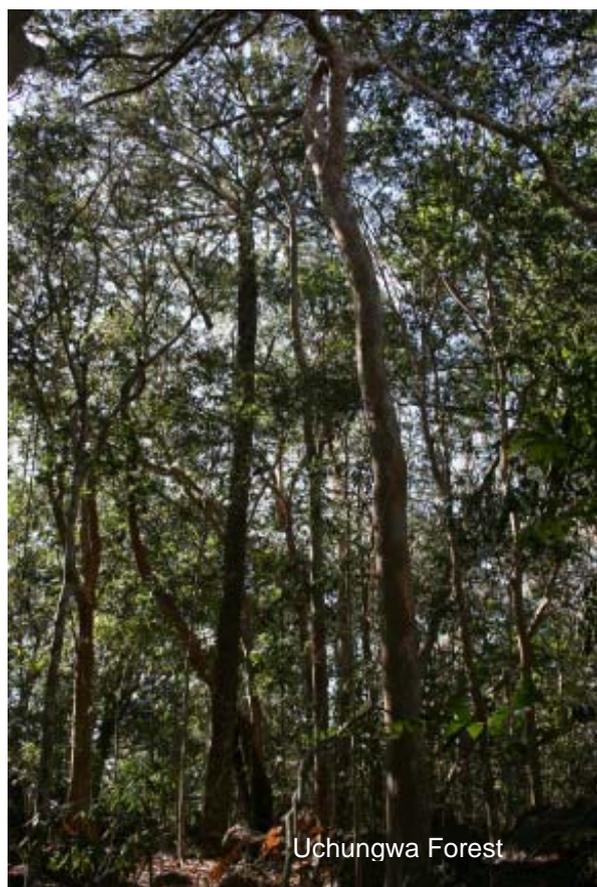
**Mitundumbea FR** protects most of the northerly part of the Ruwawa plateau. The area is mostly *Brachystegia* woodland with *Pterocarpus angolensis* and *Milicia excelsa*. There are also patches of coastal thicket and closed-canopy forest (UTUMI 2002).

#### *Mbarawala Plateau*

The Mbarawala plateau is partly protected by the **Pindirola FR** in the south though significant areas of various coastal forest types (Ca. 75 km<sup>2</sup> of scrub forest and 5 km<sup>2</sup> of mixed dry forest, (Clarke and Prins 2006)) occur outside to the N-NW. There is a mosaic of scrub forest with patches of dry forest, which appear to be similar to the ones in Ngarama FR. The scrub forest on Mbarawala plateau is similar to the scrub forest around Uchungwa Peak (Clarke and Prins 2006).



Swamp Forest in Pindirola FR.



Uchungwa Forest

At the Northern end of the Mbarawala plateau there is the Uchungwa forest (also known as Namateule or Namatimbili). This forest remains largely unsurveyed and ungazetted but remote sensing indicates significant areas of various coastal forest types including ca. 29 km<sup>2</sup> of scrub forest and ca. 34 km<sup>2</sup> of mixed dry forest. The Uchungwa and Mitundumbea forests are split by the Mavuji river which has cut a dramatic gorge through the ancient coral rag escarpment. The area contains a mosaic of different types of dry forest in pristine condition. The coral rag area contains a unique type of dry forest including high densities of the cycad *Encephalartos hildebrandtii* (UTUMI 2001). This area is dominated by the Lindi region endemic trees *Cynometra filifera*, *Cynometra gillmannii* and *Erythrina schliebenii*. The tree *E. schliebenii* was considered to be extinct (IUCN 2008). There is also a little disturbed and well developed band (ca. 3 km<sup>2</sup>) of riverine forest along the gorge of the Mavuji river.

#### *Rungo and Miturure FR*

These are mainly comprised of wooded grasslands and *Brachystegia* woodland but contain small patches of coastal thicket and forest (Clarke and Prins 2006).

#### *Coastal plain*

The satellite images for the area show an extensive area of natural vegetation to the East of Mitole. The TFCG team were able to observe the area from the road but were unable to conduct surveys there due to time limitations. Prins and Clarke's (2006) analysis of the remote sensing images indicate that there are patches of forest within this area. More research is needed to identify priority areas.

## Plants

Comparatively large areas of Coastal Forest and Coastal Scrub Forest are present on the plateaus of the Kilwa Landscape. The biological importance of these forests is still poorly known, but the few studies which have been carried out indicate that the area may be rich in endemic and restricted range species. Seeds of the tree *Karomia gigas* have been found in a tiny patch of forest in the Mitundumbea Forest Reserve – the species was thought to be extinct after the only known individual tree in Kenya was chopped down in 1983. A rapid botanical survey of the Uchungwa forest by TFCG found the tree *Erythrina schliebenii*, thought to be extinct from its original collection locality beside Lake Lutamba near Lindi. Further collections may well discover African Violets in the Rudadonga gorge system, given its similarity to the now deforested limestone gorges at Tanga where the genus *Saintpaulia* was first collected, as well as the proximity to the African Violet populations in the Kiwengoma forest in the nearby Matumbi Hills.

There are six plants that are strictly endemic to the Kilwa Landscape (data from Prins & Clarke 2007; Clarke 2001):

*Karomia gigas* – effectively endemic to Ngarama North Forest Reserve following the extinction of the only known individual from Kenya

*Erythrina schliebenii* – effectively endemic to Uchungwa forest following its probable extinction from the lake Lutamba area.

*Pterygota* sp. nov. – Uchungwa forest

*Trichilia* sp. nov. aff. *lovettii* – Uchungwa forest. Probably the same *Trichilia* sp. nov found in Chitoo Forest Reserve in 1995.

*Baphia* cf. *keniensis* – Ruwawa Plateau (Ngarama North and South Forest Reserves)

*Leptactina* cf. *oxyloba* - Ruwawa Plateau (Ngarama North and South Forest Reserves)

During the brief surveys carried out by TFCG, the team recorded 110 plant species of which 89 are considered forest species. This includes six plant species which are endemic to the Lindi landscape (*Erythrina schliebenii*, *Monathotaxis trichantha*, *Cynometra gillmannii*, *Cynometra filifera*, *Cinnobotrys pulchella* and *Diospyros magogoana*).

In addition to Coastal Forest, there are large areas of miombo woodlands which are important sources of the timber trees *Pterocarpus angolensis* and African Blackwood *Dalbergia melanoxylon*. SE Tanzania is one of the most important sources of African Blackwood, which was heavily extracted from the Mitarure Forest Reserve during the late 1980s (Ball 2004).

## Fauna

Overall there are six species that are endemic to the Coastal Forests that have been recorded within the Kilwa landscape. A further 11 species can be considered Coastal Forest near-endemics as they have also been recorded from the neighbouring Eastern Arc Mountains (Table 1 and 2). There are no known vertebrates that are strictly endemic to the landscape.

**Table 1.** Endemic and near-endemic vertebrate species recorded from the Kilwa landscape.

Species	Kilwa CF endemics	Kilwa CF near endemics
Southern Banded Snake Eagle <i>Circaetus fasciolatus</i>		1
Green Barbet <i>Stactolaema olivacea woodfordii</i>		1
Eastern Green Tinkerbird <i>Pogoniulus scolopaceus</i>	1	
Tiny Greenbul <i>Phyllastrephus debilis</i>	1	
Green-headed Oriole <i>Oriolus chlorocephalus</i>		1
Livingstone's Flycatcher <i>Erythrocercus livingstonei</i>	1	

Species	Kilwa CF endemics	Kilwa CF near endemics
Reichenow's Batis <i>Batis mixta reichenowi</i> **	1	
East Coast Batis <i>Batis soror</i>		1
Fischer's Greenbul <i>Phyllastrephus fischeri</i>	1	
Chestnut fronted Helmet Shrike <i>Prionops scopifrons</i>		1
Kretschmer's Longbill <i>Macrosphenus kretschmeri</i>		1
Plain-backed Sunbird <i>Anthreptes reichenowi</i>	1	
Grants galago <i>Galagoidees granti</i>		1
Garnett's galago <i>Otolemur garnetti</i>		1
Red bellied sun squirrel <i>Paraxerus palliatus</i>		1
Lesser pouched rat <i>Beamys hindei</i>		1
Chequered sengi <i>Rhynchocyon cirnei</i>		1
Total	6	11

The landscape is an important area for coastal forest birds. Uchungwa, Mitundumbea, Ngarama N&S and Pindiro contain populations of Plain backed sunbird (*Anthreptes reichenowi*), and Southern-banded snake eagle (*Circaetus fasciolatus*). Other forest dependent species present in the landscape include African Broadbill *Smithornis capensis*, Little Greenbul *Andropadus virens* (only in Litipo), Tiny Greenbul (*Phyllastrephus debilis*) and Yellow-streaked Greenbul (*P. flavostriatus*). Within the landscape, the near endemic subspecies, the Rondo Green Barbet (*Stractolaema olivacea* spp. *hylophona*) is present in Uchungwa, Mitundumbea and Ngarama N&S, whilst Reichenow's Batis (*Batis mixta reichenowi*) occurs in Uchungwa, Mitundumbea, Ngarama N&S and Pindiro.

Namatimbili, Mitundumbea, Ngarama N&S and Pindiro FR is important for the near endemic Grant's galago (*Galagoidees granti*), the lesser pouched rat (*Beamys hindei*) and the Chequered elephant shrew (*Rhynchocyon cirnei macrurus*). Elephant (*Loxodonta Africana*) and lion (*Panthera leo*) occur in low numbers. There is an interesting isolated population of bush hyrax (*Heterohyrax* sp) in Uchungwa and Mitundumbea.

**Table 2.** The number of endemic vertebrate species in the Kilwa Landscape.

Total/Endemism level	Number of Kilwa Landscape endemic vertebrates	Number of CF endemic Vertebrates (not including landscape endemic)	Number of CF Near endemic vertebrates
	0	6	11
<b>Total for landscape</b>	<b>17</b>		

Survey intensity has generally been very low for this landscape and has mostly focused on birds and mammals with limited surveys of reptiles and amphibians. Almost nothing is known about the invertebrate fauna of the landscape.

### Globally threatened species

There are seven vertebrate species and 12 plant species in the Kilwa landscape that are listed as threatened according to the IUCN red-list (Table 3, 4 and 5). In terms of vertebrates this includes one endangered species, two vulnerable species and four near threatened species. In terms of the plants, there are two critically endangered species, one endangered species and five vulnerable species. *Erythrina schliebenii* is listed as being extinct although the team recorded it in Uchungwa<sup>1</sup>. Some species have not been assessed but existing data suggests that more of the endemic plants will be included on the redlist.

**Table 3.** The threatened species of the Kilwa Landscape (IUCN 2008).

Scientific name	Common name	Redlist category
<i>Lycaon pictus</i>	African wild dog	EN C2a(i) ver 3.1 (2001)
<i>Loxodonta africana</i>	African elephant	VU A2a ver 3.1 (2001)
<i>Panthera leo</i>	African lion	VU A2abcd ver 3.1 (2001)
<i>Anthreptes reichenowi</i>	Plain-backed sunbird	NT ver 3.1 (2001)
<i>Circaetus fasciolatus</i>	Southern banded snake-eagle	NT ver 3.1 (2001)
<i>Beamys hindei</i>	Lesser hamster-rat	NT ver 3.1 (2001)
<i>Rhynchocyon cirnei</i>	Chequered elephant-shrew	NT ver 3.1 (2001)

EN – endangered, VU – vulnerable and NT – near threatened.

**Table 4.** The number of vertebrates on the Redlist by reserve.

Forest Reserve	Number of vertebrates on Red list	Number of Plants on Red list
Uchungwa	7	13
Ngarama North	6	Not known
Ngarama South	6	Not known
Pindiuro	6	Not known
Mitarure	Not known	Not known
Rungo	Not known	Not known
Total for landscape	7	12

**Table 4.** Plants within the Kilwa landscape listed as threatened on the IUCN Redlist (2008)

Site	Family	Species	Habitat	Habit	RL cat
Uchungwa	Fabaceae (Caes.)	<i>Cynometra filifera</i>	F	T	CR B1+2abcde ver 2.3 (1994)
Uchungwa	Fabaceae (Caes.)	<i>Cynometra gillmanii</i>	F	T	CR B1+2abcde, C2b ver 2.3 (1994)
Uchungwa	Tiliaceae	<i>Grewia goetzeana</i>	F, W,	T	DD ver 2.3 (1994)
Uchungwa	Ebenaceae	<i>Diospyros</i>	F	T, S	EN B1+2bc ver 2.3

<sup>1</sup> A specimen of this plant is being verified by Moses Mwangoka.

		<i>magogoana</i>			(1994)
Uchungwa	Fabaceae (Pap.)	<i>Erythrina schliebenii</i>	F	T	EX ver 2.3 (1994)
Uchungwa	Moraceae	<i>Milicia excelsa</i>	F	T	LR/nt ver 2.3 (1994)
Uchungwa	Zamiaceae	<i>Encephalartos hildebrandtii</i>	F	T	NT ver 3.1 (2001)
Uchungwa	Rubiaceae	<i>Gardenia transvenulosa</i>	F, W,	T, S	VU B1+2b ver 2.3 (1994)
Uchungwa	Annonaceae	<i>Lettowianthus stellatus</i>	F	T	VU B1+2b ver 2.3 (1994)
Uchungwa	Papillionaceae	<i>Milletia stuhlmanii</i>	F,W	T	VU B1+2b ver 2.3 (1994)
Uchungwa	Rutaceae	<i>Vepris sansibarensis</i>	F	T, S	VU B1+2b ver 2.3 (1994)
Uchungwa	Rutaceae	<i>Zanthoxylum holtzianum</i>	F,W	T	VU B1+2d, D2 ver 2.3 (1994)

#### 4) Forest reserves

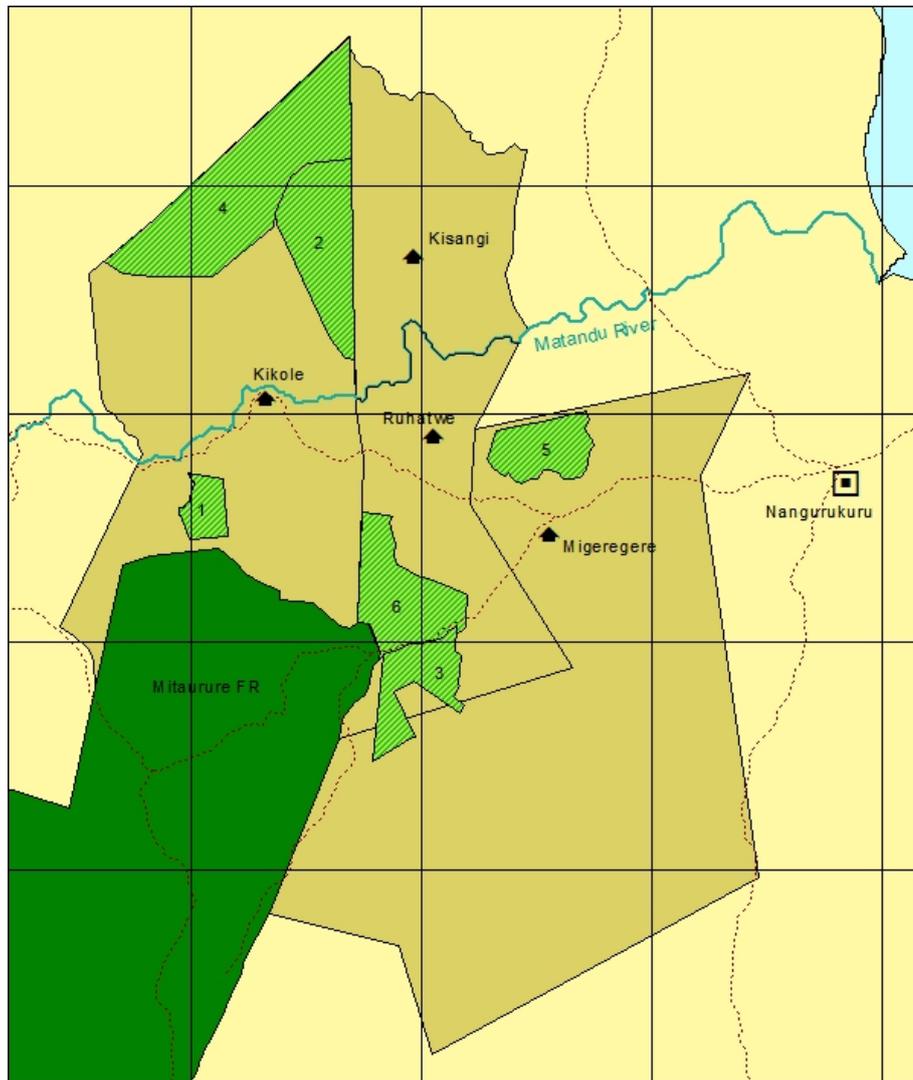
Approximately 129,520 of forest and woodland lies within six Central Government Forest Reserves within the landscape (Table 5). In addition, there are significant patches of forest and woodland that lie outside of any protected area on the Mbarawala plateau and around Uchungwa Peak. There are also four proposed or registered village forest reserves (see Map 1). Gazettement of the forest and woodland on the Mbarawala plateau should be a priority for the project.

**Table 5.** List of Forest Reserves within the Kilwa landscape

Forest Reserves	Area (ha)	Status	Altitudinal range (m)	Vegetation types
Uchungwa	Approx 10,000	Not Gazetted but parts of this signed over to BioShape	150 – 404	Dry coastal forest (coral rag type and non-coral rag type), woodland, riverine forest.
Mitaure	60,484	Central Government FR	92 – 154	Woodland, wooded grassland, coastal thicket
Mitundumbea	8,547	Central Government FR	100 – 500	Dry coastal forest, coastal thicket, woodland, riverine forest
Rungo	22,586	Central Government FR	120 – 220	Woodland, wooded grassland, coastal thicket
Ngarama North	32,628	Central Government FR	120 - 480	Dry coastal forest
Ngarama South	2,018	Central Government FR	50 - 170	Dry coastal forest
Pindiro	11,795	Central Government FR	80 - 480	Dry coastal forest, coastal thicket, woodland, riverine forest and ground water forest.
Kikole		Village Forest Reserve		Brachystegia woodland with many mpingo to the North of the Matandu River.
Kisangi Kimbarambara	2,000	Village Forest Reserve		Closed Brachystegia woodland to the South of the Matandu River
Ruhatwe / Migeregere	1,000	Proposed Village Forest Reserve		Brachystegia woodland to the East of Mitaurure
Migeregere		Proposed Village Forest Reserve to the North of Uchungwa		Woodland and Coastal Forest.



Boundary sign on the edge of Migeregere Village Forest Reserve



Map 1. Village Forest Reserves around the Matandu River

## Key



- 1 Kikole VLFR1
- 2 Kisangi VLFR
- 3 Migeregere-Ruhatwe Joint VLFR (problematic, afflicted by boundary dispute)
- 4 Kikole VLFR2
- 5 Migeregere VLFR
- 6 Ruhatwe VLFR

### Management

The District Forest Officer in Kilwa explained that he has no dedicated vehicle although if he can get fuel money, he can borrow one from the District. He has three forest officers that work with him. A fourth position is open but they have not been able fill it. He receives some support from WWF for work in the Eastern Selous project and from the WWF Coastal Forest Project. A key issue that he has been dealing with has been compensation claims from loggers whose licenses were cancelled before they had expired. He also noted that he is struggling to support communities interested to engage in participatory forest management due to limited resources.

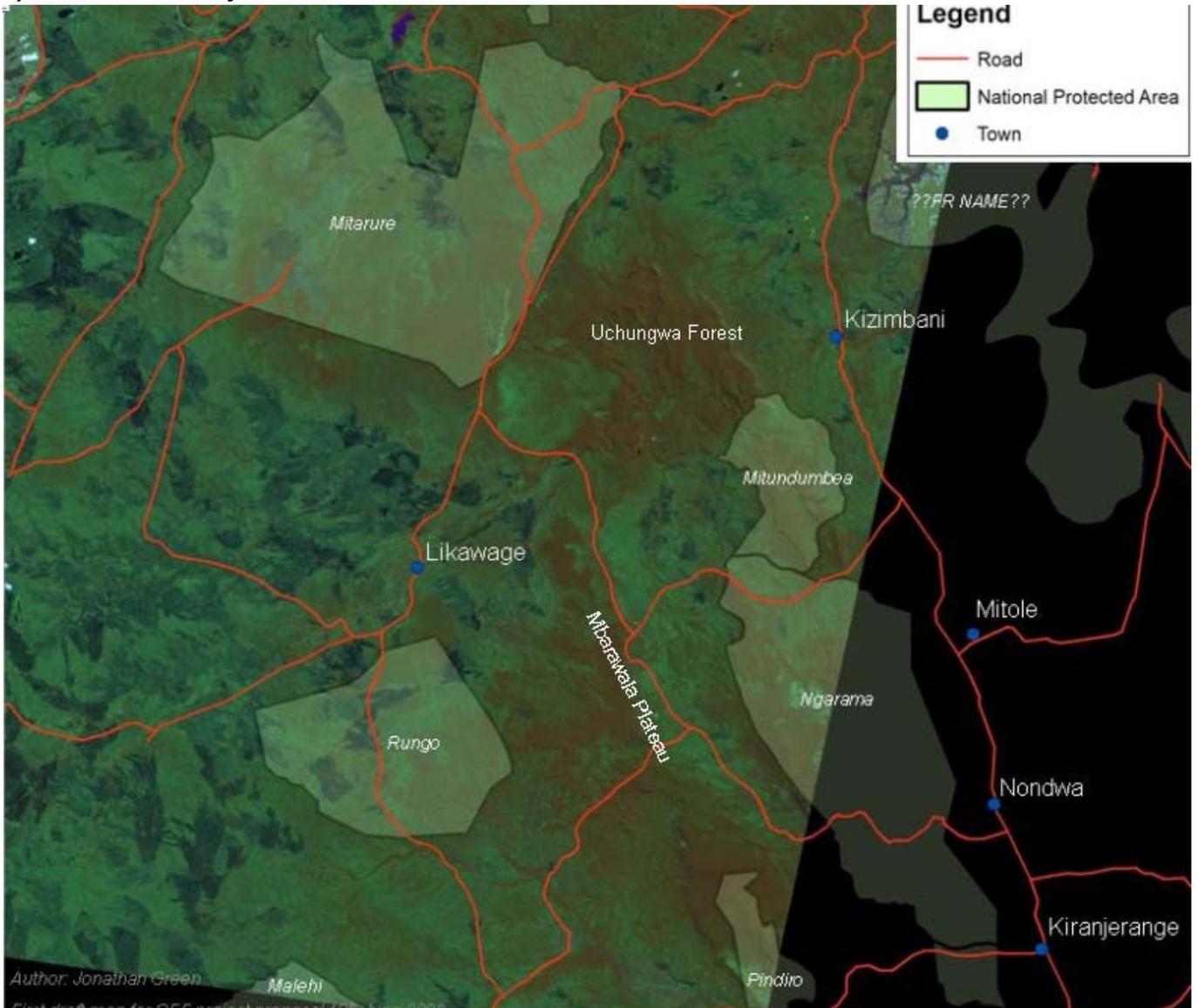
Mitaurure: the team did not visit this reserve.

Ngarama: the road passes through the reserve. No signs of boundary clearing were observed although the Village Chairperson that accompanied the team was aware of where the boundary was.

Pindiro: No sign boards, boundary clearing or beacons were observed. However villagers were aware of where the boundary was located and mentioned that the boundary was due to be extended to include the Hippo Pool.

Mitundumbea: Villagers in Mavuji were aware of where the boundary is although there were no obvious signs of where the boundary is located. No-one mentioned a management plan.

## 5) Connectivity



### **Potential buffer zones**

#### *Woodland and coastal thicket around Uchungwa*

The Uchungwa Forest is almost entirely surrounded by woodlands which also contain coastal forest vegetation patches. There are villages which conduct small scale farming in the area but impact seems to be minimal at this stage.

#### *Woodland and forest around Mitundumbea*

Mitundumbea is almost entirely buffered by woodlands which also contain coastal forest vegetation patches. There are villages which mostly conduct small scale farming in the area but impact seems to be minimal at this stage. The village of Mavuji is farming in the Mavuji basin area but extensive woodlands and coastal thicket remain. However the Bioshape biofuel project is centred here and propose to clear significant areas of the natural vegetation. This area contains patches of coastal thicket, riverine forest but is mainly *Brachystegia* and coastal woodland. Restricted range and threatened species that occur in this area include, elephant, hunting dog, lion, chequered elephant shrew and the southern banded snake eagle.

### *Woodland and forest around Ngarama N&S*



Ngarama North is buffered to the north by Mitundumbea. To the east various villages farm at the base of the hills on the coastal plain. To the west the area is buffered by a significant area of coastal forest to the north of Mkangaga village which links to Pindiuro FR. To the north there is an area of woodland and coastal forest mosaic which has not been surveyed. Demarcating the southern boundary of Ngarama S is Mbwemkuru river. In this area there are settlements and farming in the river valleys

### *Woodland and forest around Pindiuro*

Pindiuro appears to be well buffered by woodlands and coastal forest patches apart from the southern parts where there is intensive farming for rice, bananas and maize in the floodplain of the Pindiuro River. Further south as the farming intensity reduces there is more woodland and forest vegetation (exact composition not known). To the east of Pindiuro is the valley of the Pindiuro river and the Ngarama N & S FRs. Most of the intervening land in the valley is dry coastal forest. In discussions with Mkangaga Villagers, it was mentioned that this area is part of a proposed village forest reserve. To the west of Pindiuro the escarpment continues for a little before dropping down to the plain. The escarpment is mostly forested with coastal dry forest and other areas are dominated by woodland dominated by *Brachystegia microphylla*. The westerly slopes are unsurveyed but are likely to be coastal dry forest mixed with patches of woodland (UTUMI 2002).

### *Other forested areas*

North of Pindiuro FR is about 20 km<sup>2</sup> of coastal forest, dominated by mixed scrub forest. Adjacent to this an additional 60 km<sup>2</sup> of mixed scrub forest and further north another 30 km<sup>2</sup> of mixed scrub forest and legume dominated forest (UTUMI 2002).



There are still existing large patches of coastal thicket and dry forest on the coastal plains. To the east of the main Dar to Lindi road south of Kilwa town to Kiranjeranje, there are a series of low lying hills with areas of dry coastal forest and thicket. These areas are ungazetted and biologically unsurveyed. Some are likely to be secondary regenerating coastal forest cleared previously for farm land. These

areas are likely to hold many coastal forest endemic and near-endemic species.

### **Potential corridors**

#### *Uchungwa*

There are potential corridors to the north west linking Uchungwa with Mitaure FR. This is mostly woodland with scattered farms.

#### *Pindiuro to Ngarama North*

There is an existing corridor linking Pindirol and Ngarama north FR. This is mostly dry coastal forest and woodland patches together with scattered farms.

#### *Pindirol to Mitundumbea and Uchungwa*

Satellite imagery indicate a potential corridor linking Pindirol north along the Mbarawala plateau north to Uchungwa forest. This corridor is approximately 35 km long with a width ranging from approximately 3-15 km. The area is a mosaic of dry coastal forest, coastal thicket, riverine forest and woodland. Some villages occur in the area but it is sparsely populated in general and lacks infrastructure such as roads.

### **6) Resource use and Threats**

Kilwa is an ancient 15<sup>th</sup> & 18<sup>th</sup> Century capital of the Swahili culture. The eastern coastal areas of the Kilwa Landscape have therefore been heavily modified by human activity. Further inland the Kilwa Landscape area is sparsely populated and large areas of forest are still present on the Ruwawa and Mbarawala plateaus. These have been logged for their most valuable timber species but are otherwise comparatively little threatened by shifting cultivation, probably as a consequence of a major depopulation of the area following reprisals by the German colonial authorities after the end of the 1905 'Maji-Maji' uprising. This has significantly reduced the pressure on natural resources and may be the reason for the survival of the large ungazetted block of Coastal Forest north of the Pindirol Forest Reserve on the Mbarawala Plateau and at Uchungwa north of the Mitundumbea Forest Reserve (Prins & Clarke 2007).

Based on interviews with people from Migeregere Village and on data collected along two 50 m long and 10 m wide transects in the Uchungwa Forests as well as observations elsewhere in the landscape, the forests provide important resources to local people. These resources include: timber, poles, charcoal, local medicines, fuelwood, land for cultivation, wild meat, honey, mushrooms, wild fruits, wild vegetables, water, building materials such as thatches, land for settlement, clean air, rain and fees from visitors to the forest. There is also some occasional commercial hunting in the woodlands for big game.

Disturbance appears to be most intensive close to the main road where much of the natural vegetation has been cleared to prepare agricultural land.

Agriculture in the Kilwa landscape is a mixture of subsistence cultivation of cassava, maize, beans, sweet potatoes and pigeon peas. Irrigated rice is a significant cash crop close to Pindirol where there is an agricultural extension officer supporting villages to improve rice yields. There are some areas of cashew nut production.

In two transects carried out by the TFCG team in woodland and forest in the Uchungwa area no pole or timber cutting was observed. The only sign of disturbance was fire. However there has been widespread commercial timber harvesting for *Dalbergia melanoxylon*, *Milicia excelsa* and *Pterocarpus angolensis*.

Gypsum mining was observed in forest belonging to Makangaga village between Pindirol and Ngarama Forests.

Charcoal was being sold in Migeregere and at the Nangurunkuru roundabout. According to the Mpingo project, charcoal production is increasing albeit still at a low level compared to areas further North.

Although rates of disturbance are low at present, it is likely that as resources closer to Dar es Salaam are exhausted, so pressure will grow on the Kilwa landscape.

There is also a proposed biofuel project, known as BioShape, that plans to plant jatropha in three areas within the landscape: near Mavuji village to the east of the Uchungwa Forest; a proportion of northern Uchungwa forest on Migeregere Village land and an area to the west of Namatimbili that includes some of Uchungwa forest in the lands of Ninokwe Village. At the time of writing this proposal the only forest that has been cleared for the jatropha lies outside of the landscape to the East of the main Dar – Mtwara road. However the villages have already signed over the land to the Tanzania Investment Centre although accounts of exactly where the BioShape land differ.

## 7) Conservation issues

The Kilwa Landscape contains two of the larger extant blocks of Coastal Forest on the Mbwara Plateau and at Uchungwa, neither of which is under any form of legal protection. These forests need to be gazetted and protected as soon as possible, particularly as Kilwa District is beginning to see new investment and development initiatives that could pose a new threat to its forests. Large areas of previously uncultivated land have been tied up as concessions for plantations, including the northern part of the Uchungwa forest which is now owned by the Tanzania Investment Centre on behalf of the Dutch bio-fuel company BioShape Holdings B.V.

Further research is needed to assess the scale and impact of the gypsum mining in the forest on village land to the East of Pindi.

There is also a need for further research on the biodiversity values of the forests in the Kilwa landscape. Considerably less effort has gone into documenting the plants and animals of this landscape relative to the Rondo and Matumbi landscapes. As such it is possible that other endemic species exist within this landscape that have not yet been recorded.

Although no detailed socio-economic study was carried out by the team, it was observed that in Migeregere there was a mixture of traditional mud / pole houses with thatch roofs and cement brick houses with corrugated iron roofs. Migeregere also had a Japanese borehole with storage tank providing clean water to the village. People travel considerable distances to their farms whilst maintaining their family home in the main village. Although there is no connection to the national grid some houses had solar power. Pindi appears to be wealthier due to the irrigated rice cultivation. Several houses had solar panels and televisions. Water is a key issue for many of the villages as much of the ground water is slightly brackish. Villages close to clean, permanent rivers such as Pindi are at a significant advantage.

### Eco-tourism

Despite the current remoteness of the Kilwa Landscape, it nonetheless has the potential to become a tourist destination in the long term. South-East Tanzania has recently started to develop its own tourist industry centred around the beaches of Mtwara and the Mnazi Bay Marine Reserve, and with the recent construction of an all-weather road from Mtwara/Lindi to Kilwa, it is only a matter of time before the fine beaches along much of the shore of the Kilwa Landscape are developed to give a unique destination that can be combined with Kilwa's UNESCO World Heritage sites. Once this happens, the hippo pool at Pindi and the Rudadonga gorge could well become destinations in their own right, particularly if African Violets are found at the latter site.

Other village based wildlife tourism might be developed in the village lands where large game are known to visit certain water holes at various times of the year. This would require further investigations to assess any viable potential. Possible target villages are Migeregere and Nainokwe.

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## Appendix 1: Indicator species in Uchungwa forest

Forest	Uchungwa	Uchungwa	Uchungwa
Date	120708	120708	130708
Transect Number	8	9	
Transect length	500	500	
Easting start	5420201	519935	No GPS point available
Easting end	5419738	520450	No GPS point available
Northing start	9003209	9004699	No GPS point available
Northing end	9003074	9004751	No GPS point available
Altitude			
Vegetation type	Dry evergreen forest	Woodland	Dry evergreen forest
Dominant canopy species	<i>Sterculia appendiculata</i> , <i>Milicia excelsa</i> , <i>Thespesia garckeana</i>	<i>Lannea schweinfurthii</i> , <i>Combretum molle</i> , <i>Pteleopsis myrtifolia</i>	<i>Terminalia sambesiaca</i> , <i>Cynometra gillmanii</i> , <i>Dialium</i> <i>holtzii</i>
Common understorey tree, shrub and herb species	<i>Rinorea iliicifolia</i> , <i>Cola greenwayi</i> , <i>Uvariadendron sp.</i>	<i>Diplorrhynchus condylocarpon</i> , <i>Catunaregan spinosa</i> and <i>Acacia nilotica</i>	<i>Suregada lithoxyla</i> , <i>Rinorea iliicifolia</i> and <i>Grandidiera sp.</i>
Canopy height (m)	10	20	15-20
% Canopy cover	> 50	< 50	> 50
Topography	Valley floor		Ridge
Signs of resource use:	None	Logging in the past few years for <i>Millettia stuhlmannii</i>	Logging in the past few years
Afzelia quanzensis trees	2		15
Pterocarpus angolensis trees			
Milicia excelsa trees	1		
Millettia stuhlmannii tree		2	21
Hymenaea verrucosa tree			2
Albizia gummifera tree			
Albizia adianthifolia tree			
Afzelia quanzensis sapling			2
Milicia excelsa sapling	20		
Millettia stuhlmannii sapling	20		11
Hymenaea verrucosa sapling			1
Albizia gummifera sapling			

<b>Forest</b>	<b>Uchungwa</b>	<b>Uchungwa</b>	<b>Uchungwa</b>
Albizia adianthifolia sapling			
Pterocarpus angolensis sapling			
Afzelia quanzensis seedling (presence)	1		1
Milicia excelsa seedling (presence)	1		
Millettia stuhlmannii seedling (presence)		1	1
Hymenaea verrucosa seedling (presence)			1
<b>Presence</b>			
Saintpaulia ionantha			
Baikiaea ghesquiereana			
Tessmannia densiflora			
Cynometra filifera			
Cynometra gillmannii	1		1
Cynometra longipedicellata			1
Scorodophloeus fischerii	1		
Streptosiphon hirsutus			
Erythrina schliebenii	1		1
Karomia gigas			
Gigasiphon macrosiphon			
Encephalartos hildebrandtii	1		1

## **Appendix 2: Resource use interviews**

### **Resource use interviews in the Rondo and Kilwa landscapes**

**By Charles Leonard, Research Officer, TFCG**

#### **Introduction**

Most local communities in rural Tanzania, depend on natural resources to support their livelihoods. In the Coastal Forests of Tanzania, the resources used most frequently include timber and non-timber forest products and services such as medicinal plants and game.

The resource use surveys were conducted by the TFCG Research Officer in four villages: Ntene, Kinyope and Ruhoma in the Rondo / Noto landscape, Lindi District and Migeregere village in Kilwa landscape in Kilwa District. Also, Makangaga village in the Kilwa landscape was visited briefly for the survey. The aim was to gather information on the various uses of forest products and services by the local communities in the landscape. There are about 4,900 people in Ntene village, 2,326 in Kinyope and about 400 people in Ruhoma village. People in these villages are belonging to Wamwera tribe and some immigrants including Wamakonde (in the Rondo landscape) and Wangindo, Wamatumbi, Wamwera and immigrants such as Wasukuma and Wanyasa in the Kilwa landscape. Most of the villagers are peasants and own plots of land which vary in size from two to five acres. The size of their families varies, with an average of six to seven members per family or even more than that. They cultivate mainly subsistence crops including maize, sorghum, coconuts, pigeon peas and beans.

#### **Methods**

Interviews were conducted to selected group of local villagers. Due to time constraints, the greatest effort was targeted to interview members of the Village Natural Resources Committees and other few people who were knowledgeable with the natural resources in their areas. The groups included men and women. At the start of the interview, the researcher explained the purpose of the interview, which was to collect information on their resource use in the landscape. Then questions on various resource use were asked, which were based on the following points:

- Forest products and services timber and non-timber that they commonly use. The respondents were also asked to gauge them on the four levels of importance: important, of medium importance, of low importance and non-important
- Information on the products and services which are marketed and those for domestic consumption and where possible to gather their 'shilling' values and volumes/amounts consumed over a month/year.
- Any forest goods and services that might exist but so far not utilized eg. ecotourism, water etc
- Key stakeholders/players in the forest management (and mismanagement)
- Forest dependency: whether the local communities are forest dependent or not.

#### **Sampling intensity**

Interviews were conducted with four different groups in the four villages of the Rondo and Kilwa landscapes between 4<sup>th</sup> – 14<sup>th</sup> July 2008. The sizes of the groups were as follows: 13 (9 men, 4 women) interviewees in Ntene, nine (7 men, 2 women) in Kinyope, 15 (10 men, 5 women) in Ruhoma village and 20 (14 men, 6 women) interviewees in Migeregere village.

The villages were selected in order to include villages adjacent to different vegetation types in order to understand any differences in patterns of use for different vegetation types eg. Forest vs woodland. Ntene is close to evergreen coastal forest on Rondo Plateau, whereas Kinyope is close to *Brachystegia* woodland in Makangala FR and Ruhoma is close to dry evergreen forest on the Noto plateau. Migeregere village is close to evergreen coastal forest on the Mbarawala plateau.

#### **Results**

### **Forest products and services used by the local community from Coastal Forest close to Ntene village**

In Ntene village, the respondents mentioned various products and services which they get from Rondo Forest Reserve including fuelwood, poles for constructing their houses, herbal medicines, wild meat, wild fruits, vegetables, oyster nuts, mushroom and water for their domestic use. They mentioned they get the waters from valley bottoms around the Rondo plateau including Mchindiji, Mahiwa, Chipwapwa and Maindigani valleys. The respondents also mentioned that the Rondo Forest Reserve protects them from wild animals such as elephants and also the forest is an important source of rains in their areas. They also mentioned that some people are employed by the Rondo Plantation Project. They also mentioned that the forestry project allow them to cultivate in the harvested plantation plots.

### **Forest products and services used by the local community around Kinyope village**

In Kinyope village, fuelwood, charcoal, timber, building poles, herbal medicines, meat, honey and mushrooms were mentioned as the benefits which the surrounding local community gets from Makangala forest. Other benefits include wild fruits such as **usofu**, **vitolo** and **manjichi**. They also mentioned earning money from selling timber and fuelwood from the reserve. They also mentioned that the Makangala forest, apart from playing a key role in the rain cycle in their area, it is also an important source of the Kinyope river, which is one of their dependable water supplies in their village.

### **Forest products and services used by the local community around Ruhoma village**

In Ruhoma village, the respondents mentioned the following products and services from Noto forest: poles, timber, edible root tubers, herbal medicines, wild meat, fish from the Mkomole dams, land for cultivation and economic gains such as fees from researchers who visit the forest. Other benefits mentioned included water from the valley bottoms of the plateau including dams which are in Mkomole valley, mushroom, wild fruits such as **vitolo**, **usofu**, **makungu**, **manjichi**, **matili** and **magulugai** and also the natural vegetation of the Noto forest which plays a great role in the rain cycle in their areas. They mentioned also that they feel proud to be associated with such a natural coastal forest, the resource which is absent to other neighboring villagers.

### **Forest products and services used by the local community around Migeregere village**

In Migeregere village, timber, poles, local medicines, fuelwood, land for cultivation, wild meat, honey, mushroom, wild fruits, wild vegetables including **mlenda** and **mingoko** and water were mentioned as forest products and services which the local community obtains from Namatimbili forest on the Mbarawala plateau. Other benefits included building materials such as thatches for roofing their houses, land for settlements, clean air, rains and economic gains such as fees from the visitors who visit the forest. They mentioned to get the wild meat from the forest and also from the woodlands as these areas are inhabited by various wild animals such as red duiker, common duiker, bushbuck, eland, elephants, buffalo and sable antelope. Commercial hunting is also conducted in the woodlands by the licensed hunters who obtain permits from the Kilwa District.

Also a large portion of woodland and forest of Namatimbili has been given to Biofuel plantation. Tree nurseries and water wells have already been established in the area in the initial stages of the project.

**Table 1. List of various timber and non-timber forest products and services which the communities use in the Rondo and Kilwa landscapes**

<b>Landscape</b>	<b>Village</b>	<b>Adjacent vegetation</b>	<b>Benefits (products &amp; services, timber &amp; non-timber)</b>
Rondo	Ntene	Evergreen forest  Rondo (including the plantation)	Fuelwood, poles, local medicines, wild meat, wild fruits, wild vegetables, mushroom, oyster nut, water, security against wild animals, employment, areas for cultivation, source of rains

Landscape	Village	Adjacent vegetation	Benefits (products & services, timber & non-timber)
	Kinyope	Woodland Makangala	Fuelwood, timber, charcoal, poles, local medicines, honey, wild meat, mushrooms, wild fruits, income from selling the various products such poles, source of rains and water from Kinyope river. Other benefits are milling pestle and mortar, wooden spoons, coconut grater, wooden handles for hoes and <i>pangas</i> etc.
	Ruhoma	Dry forest Noto	Poles, timber, edible root tubers, local medicines, wild meat, fish, areas for cultivation, income, water, mushroom, source of rains and proud.
Kilwa	Migeregere	Evergreen forest Namatimbili (locally known as Uchungwa forest). Other forests are Muungano and Ndwiwu VFRs	Timber, poles, local medicines, fuelwood, land for cultivation, wild meat, honey, mushroom, wild fruits, wild vegetables, water, building materials such as thatches, land for settlement, clean air, rains and fees from the visitors to the forest. Occassional commercial hunting in the woodlands for the big game.

Most of the poles and timbers from the forests are used as building materials. Local medicines taken from the forests include bark, leaves, roots and seeds of some plants. The medicines were mentioned to be used to treat ailments such as problems associated with human gastro-intestinal tract, dental problems, polio, eyes and nerves. Also people bitten by snakes were mentioned to be cured by some of the medicines. The respondents also mentioned that most of them rely on the forests to get their medicinal supply as the costs for modern medicines are high. In Migeregere village, about 90% of the interviewees mentioned to rely on the surrounding forests including Namatimbili for their local medical supplies. Secondly, dispensaries and hospitals are not enough in their areas and the few dispensaries which are present are stocked with insufficient medicines and also very few clinical officers including nurses.

Common duiker, suni, bushbuck, red duiker and birds such as guinea fowl and francolins and even greenbuls were mentioned as being hunted by some of the villagers. The meat is either for local consumption at the household level or for selling to other people in the village. In the woodlands around Namatimbili forest, licensed hunting for the big game such as buffalo and eland is also occasionally conducted (Table 1).

All of the benefits mentioned by the respondents were consumed locally at the village level but also the respondents mentioned some of the benefits which were traded among themselves in the village or even outside their areas. Table 2 below shows the forest products and services that are marketed in the Rondo and Kilwa landscapes.

**Table 2. List of various timber and non-timber forest products and services that are marketed around the Rondo landscape**

Landscape	Village	Adjacent vegetation	Products & services	Amount (Tsh)
Rondo	Ntene	Rondo (Evergreen forest & plantation)	Fuelwood	500 – 1,000 per bundle
			Poles	1,000 per piece
			Mushroom	300 per bunch
			Wild meat	500 per piece
			Water	500 per 20litre
			Vegetables	200 per bunch
			Oyster nuts	500 per fruit
	Kinyope	Makangala (Woodland)	Timber	3,000 per 10 ft piece
			Charcoal	4,000 per bag
			Fuelwood	100 per piece
			Honey	2,500 per litre
			Poles	500 per piece
			Wild meat	6,000 -30,000 per whole (for small antelopes such as suni and common duiker respectively) or 1,000 per piece
			Milling pestle	1,500 per piece
			Milling mortar	5,000 per piece
			Wooden spoons	200 - 300
			Coconut grater	3,000 per piece
			Wooden handles for hoes, pangas, axes etc	500 per piece
				Ruhoma
Wild meat	1,000 per piece			
Timber	2,500 per piece			
Kilwa	Migeregere	Evergreen forest Namatimbili (locally known as Uchungwa forest). Other forests are Muungano and Ndwivu	Timber	3,000 per piece
			Poles	500 per piece
			Fuelwood	250 per bundle
			Wild meat	2,500 for small antelopes such as suni
			Honey	2,000 per litre

Landscape	Village	Adjacent vegetation	Products & services	Amount (Tsh)
		VFRs	Mushroom	100 per bunch
			Wild fruits	100 per bunch
			Water	200 per 20 litre can

**Table 3. Gauging the benefits on the four levels of importance: important, medium, low important and non-important**

Landscape	Village	Adjacent forest	Benefits	Level of importance
Rondo	Ntene	Rondo	Poles	Important
			Water	Important
			Fuelwood	Important
			Wild meat	Important
			Oyster nut	Medium
			Wild vegetables	Low
	Kinyope	Makangala	Fuelwood	Important
			Charcoal	Important
			Timber	Important
			Poles	Important
			Wild meat	Important
			Water	Important
			Local medicines	Important
			Wild fruits	Less important
	Ruhoma	Noto	Poles	Important
Timber			Important	
Water			Important	
Local medicines			Important	
			Areas for cultivation	Medium
			Wild fruits	Important

			Mushroom	Important
			Fish	Important
Kilwa	Migeregere	Namatimbili	Timber	Important
			Poles	Important
			Wild meat	Important
			Local medicines	Important
			Fuelwood	Important
			Land for cultivation	Important
			Land for settlement	Important

**Table 4. Key stakeholders in the forest management**

Landscape	Forest/Plateau	Stakeholders
Rondo	Rondo	Ntene village government through VNRC and other surrounding villages such as Mihima, Liganga and Mandaware.
		Rondo Plantation Project
		Naliendele Agricultural Research College- have one hector of Eucalyptus in partnership with Ntene village
	Makangala	Village governments of Kinyope, Legezamwendo, Rutamba ya Sasa and Makangala villages through their VNRCs
		Lindi District Council
	Noto	Ruhoma village government and other surrounding villages such as Milola, Nangaru, Kinyope and Mtangi
Celtel – they have put a mast at the centre of the forest on the plateau. They have also established a road up to the tower area.		
Kilwa	Namatimbili/Mbarawala	Migeregere village government and other surrounding villages such as Nainokwe, Liwiti, Mavuji, Mchakama villages.
	Makangaga forest patch-a potential corridor btn Pindiro and Ngarama FRs and the sacred forest with the hippo pool (Nyange River forest)	The Biofuel company-Bioshape
		Kilwa District Council
		Makangaga village government
		The gypsum mining company
Kilwa District Council		

## **Forest goods and services which are unutilized in the Rondo and Kilwa landscapes**

Ecotourism is the major product which has not been utilized in the two landscapes. The two sites in the Mbarawala plateau: Namatimbili and the sacred forest at Nyange River in Makangaga village can offer a lot to ecotourism. Apart from the evergreen coastal vegetation, Namatimbili has caves which have been formed under the coral rag limestone rocks.

The Nyange River has the hippo pool which is the major tourist attraction in the area together with the pristine undisturbed forest.

The forests of the Rondo landscape can be connected to the recently established network of the tourist attractions in the southern tourist industry.

## **The extent to which the local communities depend on the forest**

In all the villages visited, all of the respondents mentioned to depend largely on the forests resources which are in their areas for livelihood support due to the benefits which they get from the forests (Table 1).

## **Discussion**

### **The importance of the forest products and services to the economies of the local communities**

The local communities in the Rondo and Kilwa landscapes are benefiting from the outlined timber and non-timber forest products such as building materials (timber and poles) and local medicinal supplies (Table 1). Most of the households are poor which implies that they can not afford economically to sustain their lives without depending on the forest resources. For instance, most of the respondents mentioned the costs for modern medicines and building materials such as cement to be high. Therefore, they opted for the building materials from the forests such as timbers, poles and thatches which appear to be cheap.

Apart from these benefits which were mentioned to be used by the local communities, there are also other under-utilized products such as ecotourism.

### **Resource use in forests and woodlands**

Generally, most of the resources mentioned to be used by respondents in the two landscapes were mentioned to be obtained from the forest areas and the adjacent woodlands. The extent of the resource uses in the forests and in woodlands varies from one area to another within the landscapes due to various reasons including population size of the villages. For instance in the eastern side of the Rondo landscape in Ntene village, the respondents reported a decrease in stock of most of the resources including timber which they were getting from the woodlands. Ntene village is one of the populated areas in the eastern side of Rondo compared to the western side where it is less populated. The woodland in the south-western side and western side of Rondo is still good in terms of valuable timber tree species such as *Azelia quanzensis* and *Milicia excelsa*.

In Kilwa landscape, most of the resource such as timbers, fuelwood and poles are obtained by the local communities mostly in the woodlands. The woodlands are adjacent to Namatimbili forest and two woodland Village Forest Reserves of Ndwiwu and Muungano in Migeregere and Ruhatwe villages. They depend on the forest for other resources such as water and local medicines.

### **Gender preferences in resource use**

Forest products such as fuelwood, mushroom, wild vegetables and fruits are normally collected by women from the forests for either domestic consumption or trading. Men are more involved with activities such as hunting wild animals and pitsawing.

## **Resource use between rich and poor communities**

During the surveys, it was evident that both the rich and poor households depend on the forest resources and services to meet their needs but in different ways. Most of the households with poor economy (which are the majority in the area) are depending on the forest resources directly to meet their needs such as building materials (poles and timbers) and medicinal supplies. The rich people buy the forest products from the poor people.

Most of the households with poor economies own small cultivation plots. Crops which are harvested such as maize and millet are insufficient to cater for their household needs. Thus, the last option is on the forest resources.

## Appendix 3: Landscape Use

By Charles Leonard, Research Officer-TFCG

### Introduction

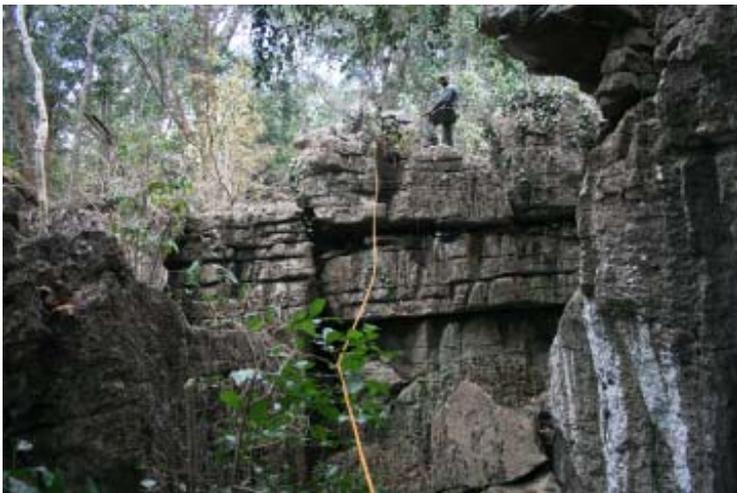
#### Objectives

The objectives of the landscape disturbance work were:

- To assess the intensity and distribution of human disturbances within Kilwa landscape
- To record the types of human disturbances affecting the Kilwa landscape

#### Methods

Disturbance transects were used to provide information on rates of timber extraction and pole cutting and other disturbances within the Kilwa landscape. The transects were conducted in Namatimbili forest including its woodland. Only opportunistic observations on the disturbances were conducted in forests of Makangaga village on the Mbarawala plateau. Disturbance was assessed within two 10 m wide transects in the landscape. Each transect was 500m in length. One transect was conducted in the closed forest and one transect in the woodlands. Transects were placed starting at the forest boundary and following a constant bearing. The bearing depended on the orientation of the forest. The location of the start and end points were recorded using a GPS.



Disturbance rates were recorded for each 50 m section along the transect lines. The level of disturbance was assessed in terms of the number of poles and timbers which were cut or left standing in a 10 m strip (5 m either side of the transect line). Poles were defined as those trees with straight stems at least 2 m in length and with 5 - 15 cm dbh. Timber trees were defined as all trees with straight stems at least 3 m in length and exceeding 15 cm dbh.

Every cut tree stump and cut pole was measured within the transect. The diameter at breast height (dbh) was measured at the standard height of 1.3 m above the ground. The diameter of cut trees and poles were measured at the point of cut. Fallen tree trunks or branches were not counted, only stumps.

Other forms of human disturbance were also recorded in the Kilwa landscape. These disturbances include: fire, paths, roads, settlement and mining.

Table 1. Number of live, dead and cut poles in the Namatimbili.

Transect number	Transect area (ha)	Total number poles sampled	Average live poles	Average dead poles	Average old cut poles	Average fresh cut poles
NM1	0.5	240	229	11	0	0
NM2	0.5	103	96	7	0	0
Total	1	343	325	18	0	0

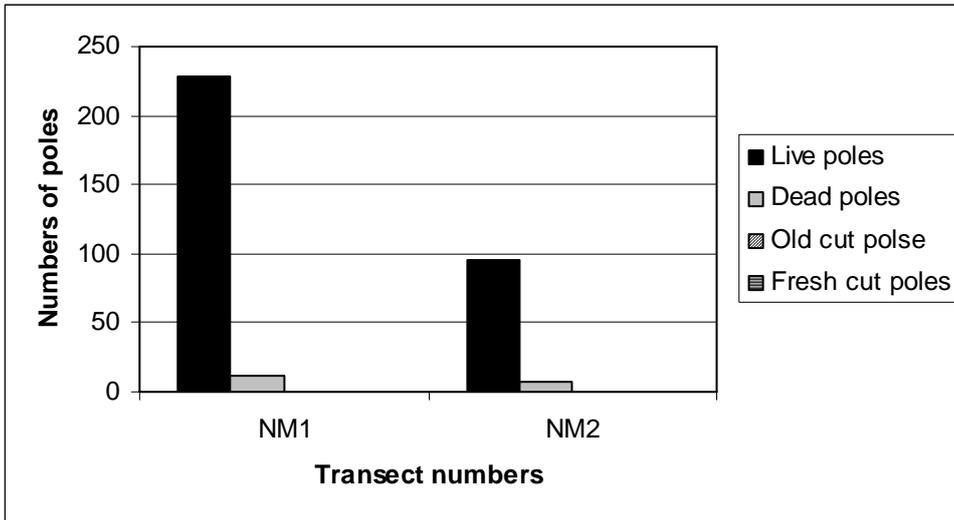


Fig 1. Abundance of live, natural dead, old cut and fresh cut poles along disturbance transects, Namatimbili

Transect NM1 was conducted in the closed forest while transect NM2 was conducted in the woodland.

Table 2. Number of live, dead and cut timbers in the Namatimbili

Transect number	Transect area (ha)	Total number timbers sampled	Average live timbers	Average dead timbers	Average old cut timbers	Average fresh cut timbers
NM1	0.5	79	73	6	0	0
NM2	0.5	59	55	4	0	0
Total	1	138	128	10	0	0

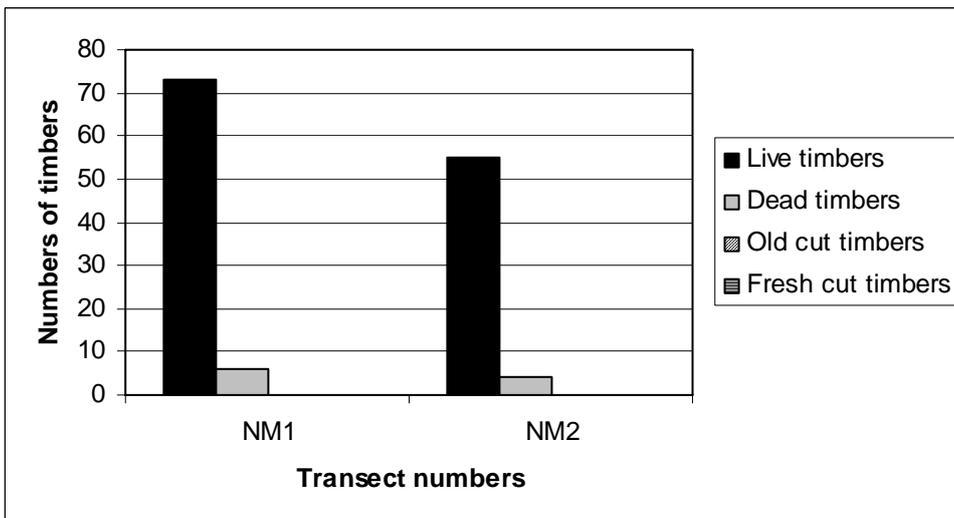


Fig 2. Abundance of live, natural dead, old cut and fresh cut timbers along disturbance transects, Namatimbili

## **Other human disturbances**

### **Namatimbili**

Fire was the only disturbance which was recorded in transect NM2 which was conducted in the woodland. No disturbance was recorded in transect NM1 in the closed forest. However, a number of cut lines which were set by the oil and gas exploration companies were noted opportunistically during our walks in the forest and in the woodland.

During the resource use interviews, the villagers at Migeregere village mentioned that licensed commercial hunting for the big game such as buffalo and eland is occasionally conducted in the Namatimbili woodlands. Similarly, they mentioned also subsistence hunting is illegally conducted both in the closed forest and in the woodlands of the Namatimbili.

### **Forests in Makangaga village**

Gypsum mining, land for cultivation and settlements are the current disturbances which are threatening the forest area around and between Ngarama and Pindirol FRs. The gypsum mining is coupled with the construction of road networks (for easy accessibility to the mining sites) and mining camps. The forest area is a potential corridor between the two forest reserves.

There is very minimal disturbance in the Nyange River sacred forest. The forest looks pristine, only road has been established to access the hippo pool.