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The status of Mtwapa Creek mangroves as perceived by the local communities

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Abstract

Local coastal communities depend on mangrove ecosystems for valuable goods and services. As a result, mangroves have suffered degradation due to overexploitation to serve the ever-increasing demand for wood and wood products, as well as human activities along riparian areas which have equally had a significant impact on adjacent mangrove wetlands. Socioeconomic characteristics of five local communities living around Mtwapa Creek were examined to establish their perceptions on the status of the adjacent mangrove forest. The results show that although local communities distance themselves from responsibility on the status of the forest which they perceived as being poor, they appreciate mangroves as an integral component of their livelihood. Secondary data on mangrove harvesting within Kilifi County reflected a possible lack of alternative sources of energy as shown by the progressive increase in illegal fuelwood harvesting over the years from 1991. The local communities recognise the potential influence of both legal and illegal harvesting on the status of Mtwapa Creek mangroves, while only a small proportion perceive observed anthropogenic activities in riparian areas as a possible threat to mangroves. These findings have been obtained against a backdrop of mixed opinions amongst local coastal communities which is associated with gender, living standards, education level and knowledge about mangroves as a resource.

Keywords: mangrove status, local communities, perception, human activities

Introduction

Mangroves provide products and services at both the local scale and beyond, but local communities may have the closest relationship to mangroves through their livelihoods and direct impacts. It therefore follows that the perception of both utilization and impact are intimately related. The basis of local livelihoods associated with mangroves may include timber and non-timber forest products (Dahdouh-Guebas *et al.*, 2000; Balmford *et al.*, 2002) as well as the associated ecosystem goods (Saenger, 2002; Crona and Rönnbäck, 2005; Lee *et al.*, 2014) which can be harvested by local communities within the mangroves or adjacent systems. Depending on the quality of the forest, mangroves may prevent coastal erosion and play a crucial role in mitigating disaster risk by acting as barriers that dissipate wave energy (Dahdouh-Guebas *et al.*, 2005; Latief and Sofwan, 2007; Lee *et al.*, 2014). The arguments by these authors align with those of Das and Vincent, (2009) who used data on several hundreds of villages to prove that mangroves would indeed protect lives in incidences of cyclones and tropical storm surges. Mangroves also help in sediment stabilization (Kimeli, 2013) and

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mitigation of climate change through their high carbon storage capacities (Donato *et al.*, 2011).

Owing to the multiple benefits that accrue from mangrove ecosystems, establishing a balance between the use and non-use values still remains a challenge (Millennium Ecosystem Assessment, 2005; Okello *et al.*, 2012). This is because the benefits attached are not always tuned to accrue at the same time scale and to the same people. In fact, while making important steps towards achieving the vision 2030, Kenya for instance is still encountering challenges in reversing environmental degradation (Government of Kenya, 2007). As a result, mangroves have faced continued cover loss in Kenya (Kirui *et al.*, 2012) as well as globally (Duke *et al.*, 2007; Spalding *et al.*, 2010). The progressive rise in population in coastal areas (McGranahan *et al.*, 2007; Samoilys *et al.*, 2015), and the consequent increasing demand for agricultural land, urban development as well as other forms of related anthropogenic disturbances have subjected mangroves to increased pressure and degradation (Bosire *et al.*, 2013). In fact, degradation due to development may require the longest time to restore mangrove functionality as opposed to other forms of degradation (Mukherjee *et al.,* 2014).

Several attempts have been made worldwide and in Kenya to restore degraded mangrove areas (Field, 1996; Kairo *et al.*, 2001; Okello *et al.*, 2012; Kodikara *et al*., 2017) and to ensure effective management of these forests. It has however been noted that conservation and sustainable management is a superior strategy to restoration or reforestation (Vannucci, 2004). Since the declaration of mangroves as government reserve forests in 1932 (FAO, 2007), their management has been limited to the licensing of extraction of wood products, authorized by the Ministry of Environment and Natural Resources; where annual quotas for extraction are decided on an unspecified basis, and extraction operations are not always supervised (FAO, 2007). The Forest Conservation and Management Act, 2016 (No. 34 of 2016) however, provides for involvement of the private sector and local people in mangrove management through the formation of Community Forest Associations (CFAs) (Samoilys *et al.*, 2015), a system that is quickly picking up pace along the coast, and could offer a breakthrough (Frank, 2014). Further, the assumption that people always destroy mangroves has been put in question following self-initiated mangrove planting and management programmes by the local people (Walters *et al.*, 2008).

Socio-economic studies have been conducted among various communities living adjacent to mangrove forest patches in Kenya to analyze utilization pattern and establish possible cause-effect relationships between the people and these forests (Kairo, 1992; Dahdouh-Guebas *et al.*, 2000; Mohamed, 2009). However, since demographic characteristics of local human communities may vary significantly from one geographic locality to another (Government of Kenya, 2012), each mangrove area has to be treated as a separate entity for purposes of effective integration into national management plans. It is also important to incorporate local perceptions in order to ensure successful conservation ventures of natural resources (Nazarea *et al.*, 1998; Horowitz, 2001; Marcus, 2001; Frank, 2014). This study highlights the nature of activities of the local human community and the impacts they may exert on the bordering peri-urban mangrove ecosystems. Such understanding of how socioeconomic characteristic influence people's values of the environment can be an important tool in the development of an effective conservation strategy while solving the real causes of degradation of a resource (Cinner and Pollnac, 2004). The underlying hypothesis was that socioeconomic status (village, education, income, gender, house type) is associated with the nature of activities carried out by local communities and their perceptions on the status of adjacent mangrove ecosystems.

Materials and Methods

Study site

The study was conducted in five villages along Mtwapa Creek, Kenya (3° 57' 0 S, 39° 45' 0 E), bordering Mombasa and Kilifi counties to the south and north respectively (Fig. 1). The villages (Kashani, Kidutani, Mdengerekeni, Mtepeni and Mtomondoni) which border the creek on both shores were chosen purposively based on proximity to the mangrove forest (Fig. 1).

As per the Kenya electoral boundary commission, the surveyed villages fall under two sub-locations, Shimo la Tewa and Mtepeni (Government of Kenya, 2012), which have a population density of 21 and 65 persons per km^2, respectively (Government of Kenya, 2010). Data obtained from the village heads of Kashani, Kidutani, Mdengerekeni, Mtepeni and Mtomondoni villages indicate that they have 142, 258, 92, 284 and 308 households, respectively.

Current laws ban individuals from cutting mangroves, unlike previously when licenses were issued to

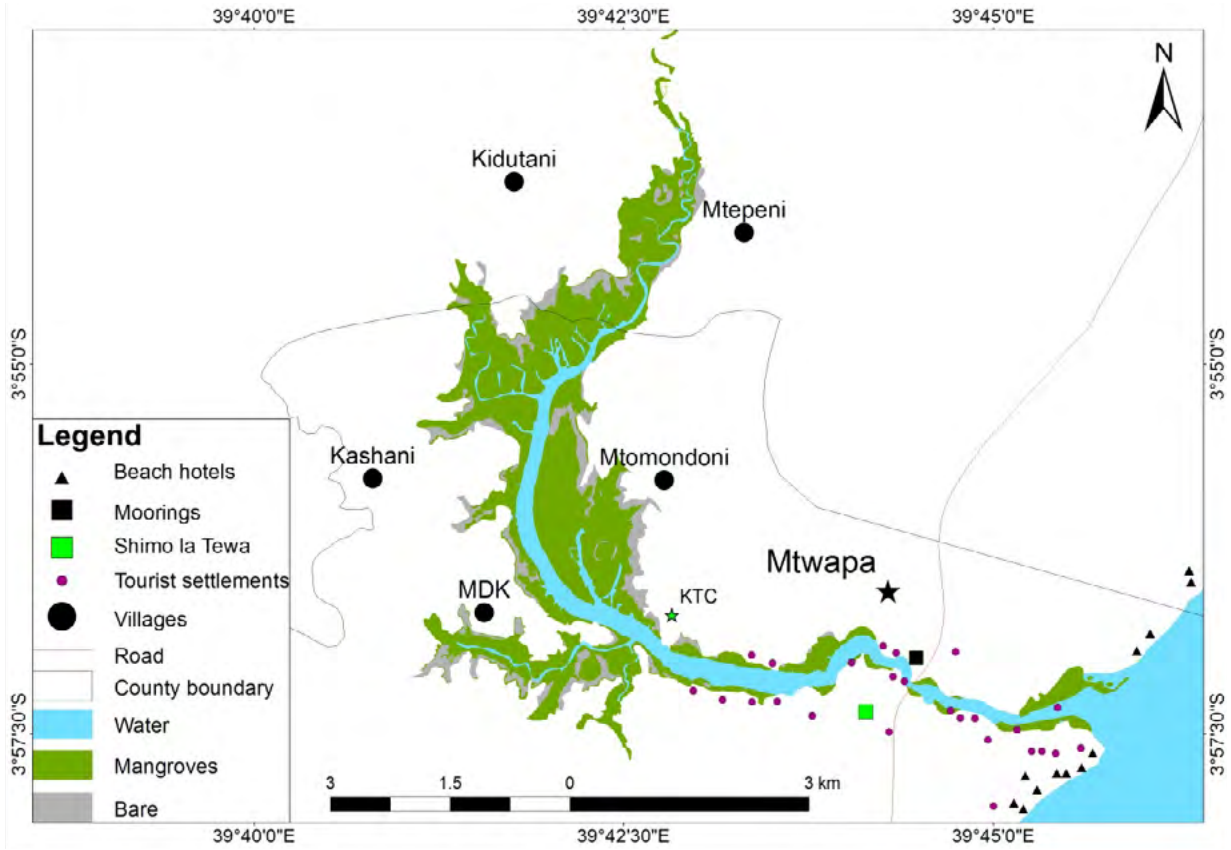

Figure 1. Map of Mtwapa Creek showing the location of the five villages, Mtomondoni, Mtepeni, Kashani and Mdengerekeni (MDK), within which the study was conducted. Inset is the map of the entire Kenyan coastline locating the creek. Kwetu Training Center (KTC) and several hotels and tourist settlements are also shown as well as the Shimo la Tewa prison. Source: CORDIO East Africa, Kenya

mangrove cutters, most of whom do not live around the study area. With the supervision of the Kenya Forest Service (KFS), such individuals were expected to cut within a given locality. In Mtwapa Creek, no such licenses have been issued since the placement of a presidential ban on local harvesting of mangroves in the year 2000 (Abuodha and Kairo, 2001), allowing the local community to only collect dead wood for use as firewood upon being issued with permits by KFS. Such permits costs about half a dollar per week and a bundle of firewood (*tita*) is sold for USD 1.19–1.78 (exchange rate USD 1 = KES 84, in 2011).

Methods

Primary data was collected in April 2011 to gain insights on the socioeconomic characteristics of the local communities and their perceptions of the status of the mangrove forest of Mtwapa Creek. This was achieved through a combination of participant observation (captured in photographs and transect walks), semi-structured questionnaires, key informant interviews, and focus group discussions (Bunce *et al.*, 2000). Kiswahili was the general language used in communication and where necessary, the local language (of the indigenous inhabitants who were from the native Mijikenda community) was integrated into the conversations to enhance understanding. The questions were administered by Okello, Mwakha and the Kenya Marine and Fisheries Research Institute (KMFRI) socio-economic team (see acknowledgement). The team was assisted by one member of the local community identified by each village head and who could identify well with the people and speak the local language fluently. The following section details the data collection methods that were applied.

Participant observations – where the researchers got involved in the activities of study - these were useful to enhance understanding of activities and as a way to bond with the respondents, and obtain insight into what the activities meant to them. Transect walks and photographs were mainly employed to capture activities and features of specific interest, as well as to identify adversely impacted scenarios, both on land and in mangrove ecosystems.

Semi-structured interviews – were administered to systematically selected households from a full list of households in the five villages provided by the village heads. Selection of households was carried out by the team without influence from the village heads by picking every third home in a row. In cases where a selected household was absent during the survey, the next home in the row would be visited. Only one member per household (in most cases the household head) was interviewed with the exception of where another member contributed significantly to the family earnings. A total of 17, 31, 11, 34 and 37 persons, making up 12% of the total number households provided by the village heads, were interviewed in Kashani, Kidutani, Mdengerekeni, Mtepeni and Mtomondoni, respectively. These individuals were from 122 households in the villages (Table 1). Questionnaires containing both open- and closed- ended questions were applied. In this way, it was possible to probe answers, follow up on questions as they appeared in the questionnaires, and pursue new ideas. The questions explored their demographic and socio-economic characteristics; their perceptions on the state of mangroves and harvesting techniques of mangrove-related products for various uses; as well as land-based activities they were engaged in. Material style of life indicators which are regarded

Table 1. Description, mean and variation of the respondents living in the 5 villages surveyed around Mtwapa Creek. Only two of the respondents from Mdengerekeni were not natives of the area, while the rest were all Mijikenda.

Indicator	Description	Villages	Range (mean ± standard deviation)
Age	Age of respondents	Kashani	20–59(38.0±12.4)
		Kidutani	18–80(46.2±19.2)
		Mdengerekeni	23–66(45.5±13.4)
		Mtepeni	18–70(43.6±15.5)
		Mtomondoni	19–85(47.2±17.5)
		Total	18–85(44.7±16.6)
Gender	Percentage number of respondents of a given sex	Kashani	Male 76.5%; Female 23.5%
		Kidutani	Male 61.3%; Female 38.7%
		Mdengerekeni	Male 90.9%; Female 9.1%
		Mtepeni	Male 41.2%; Female 58.8%
		Mtomondoni	Male 48.6%; Female 51.4%
		Total	Male41.2%–90.9%(63.7±20.4%)
			Female9%–59%(36.3±19.2%)
Household size	Number of individuals per household includingdependants both children (< 18 years old) & adults (>18 yearsold)	Kashani	1–10(3±3)
		Kidutani	2–15(7±4)
		Mdengerekeni	2–11(6±3)
		Mtepeni	4–24(8±4)
		Mtomondoni	1–21(7±4)
			Total1–24(7±4)
Income	Percentage number of respondents with selected income ranges earned per week (1 US$ = KES 84)	US$0–5.95	10%–46%(31±13.2%)
		US$5.96–11.90	11%–40%(26±11.1%)
		US$11.92–17.86	9%–40%(18±12.4%)
		US$17.87–35.71	8%–32%(19±10.7%)
		US$>35.71	0%–16%(6±7%)

as measures of the wealth of households were recorded in each case. These included mode of house construction, including house type (permanent, semi-permanent, temporary); roof type (coconut fronds-*Makuti*, other leaves, iron sheets or tiles); wall type (*Makuti*/ other leaves, poles and mud, stones/bricks, other); cooking fuel (fuelwood, charcoal, kerosene, other) and lighting fuel (kerosene, candle, electricity, other).

Key informant interviews – provided qualitative data that were used for triangulation of the results. The key informants were selected through prior communication with the village heads in order to gain confidence of the individual. This is because mangrove harvesting is considered a sensitive issue and local communities tend to shy away from discussing it. The village heads together with the key informant also helped identify participants for focus group discussions in each village. Willingness to be interviewed was the overriding factor for individuals to join the discussion group. Other factors such as gender balance and main economic activities of the respondents were used as secondary criteria. One focus group discussion was conducted in each of the five villages. Each focal group had 5-10 members with whom a series of open-ended questions were discussed.

Questions regarding knowledge were gauged as follows:

- Good working knowledge: Interviewee is able to explain what mangroves are, to identify at least three common species, and to identify at least three uses of mangroves
- Rough idea: Interviewee can associate mangroves with the intertidal area but does not know species. He/she knows the main use of mangroves in the area
- No idea: Interviewee does not know anything related to mangroves

Secondary data on mangrove utilization in Kilifi County was obtained from the draft national mangrove management plan (NMMP, under preparation). The data available was for between the year 1990 and 2012 and obtained from the NMMP working group. Additional information was provided by the Kenya Forest Service (KFS) and the municipal council of Mtwapa town.

Data analysis

Data analysis was carried out using Ms Excel table sheets and SPSS 17.0 software. The analyses employed were mostly descriptive, which help to transform raw data into a form that summarizes a set of factors in a way that is easy to understand and interpret. Various quantitative variables in the study were also tested for relationships. The data sets by village did not meet the normality and homogeneity of variance requirement of parametric tests, even after being transformed. The Kruskal-Wallis test was therefore used, with no statistically significant differences in age of respondents between the villages visited being noted ($H(4) = 3.287$, $p = 0.511$). In subsequent statistical tests, the villages were therefore considered as one entity when dealing with age. Association among various variables was tested using the Pearson Chi-squared test. The 18 items used as material of life indicators were factor analyzed using principal component analysis techniques and varimax rotation resulting in two factors that explained the variance. The items that had the highest positive loadings have a stronger contribution on wealth than those with low or negative loadings (Cinner and Pollac, 2004).

Results

Socio-economic profile of the respondents around Mtwapa Creek

The overall male to female sex ratio of the respondents was 6:4. However, there were variations in other characteristics among the villages surveyed (Table 1). Only two respondents from Mdengerekeni were from the Kisii and Kikuyu tribes, while the rest of those interviewed belonged to the Mijikenda, which is the native tribal group in the area. The primary data collected showed an overall mean household size of 6.7±0.3 members with Mtepeni village having significantly higher frequencies of large household sizes ($F=4.066$, $p<0.05$, $N=130$). Ninety-four percent of all the respondents were household heads while the rest were dependants who lived with their parents or guardians but contributed in one way or another to the household's income.

Education levels were quite low among the respondents. On average, most of the respondents had primary level education (48.8%), with the smallest proportion attaining secondary education (7.9%), while the remaining respondents had no formal education.

Livelihoods of Mtwapa Creek local communities

Most respondents (31%) reported an average annual income of less than US$ 285.6 (Table 1). This value also included goods for direct consumption produced by each household.

Farming provided the major source of income in the

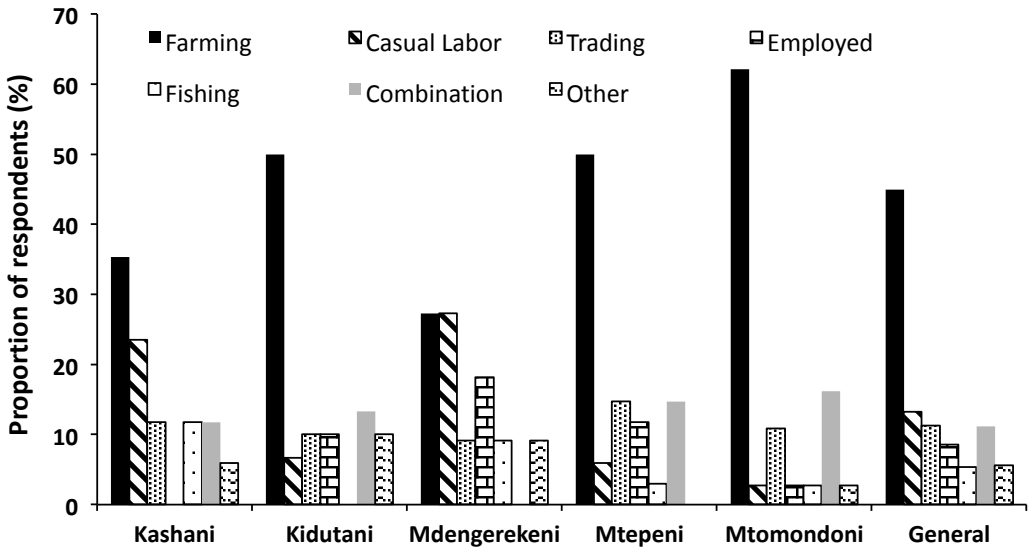

Figure 2. Economic activities of the people living in the five villages surveyed around Mtwapa Creek.

area contributing more than 60% of the total revenue. A total of 49.6% of the respondents practiced farming (Fig. 2) with 67% of these farmers engaged in farming as a full-time activity. Casual labour and trading in small-scale businesses involving fast moving household goods (mainly food stuffs) was generally considered the second and third most important source of livelihood respectively by local communities, but there were variations from village to village (Fig. 2). Those living in Kashani and Mdengerekeni had the least number of respondents depending on farming with relatively high proportions as casual labourers in building and construction industries and on farms. Mdengerekeni also had the highest relative proportion of those employed on either a permanent or contract basis working in the beach hotels, or as teachers in schools and in various industries in Mombasa city and Mtwapa town.

Other important income generating activities that the respondents engaged in included fishing and masonry. Although fishing was considered important, it only accounted for 3.9% of local community income sources as it was practiced by a small proportion of people living close to the creek, mainly in Kashani and the adjacent villages of Kidongo and Majaoni. The fishing was artisanal, undertaken for both subsistence and commercial needs. The fishermen used small traditional fishing boats and cast nets or employed hook and line techniques. Fish catch seldom reached the nearby Mtwapa town as it was often sold at the landing site directly to the local communities, or to local fish traders who supplied fish within the same villages.

From the focus group discussions, it emerged that both farming and fishing have encountered dwindling returns over the years. Fish catches were reported to have progressively declined, attributed to reduction in the depth of the creek. The reduction of depth was said to be as a result of sediment deposition in the creek waterways, although the local fishermen were not able to systematically ascertain the sediment source. Farming, on the other hand, had been affected by bad weather conditions and the escalating cost of farm inputs forcing men to seek employment as casual laborers in the fast-expanding town of Mtwapa and Mombasa city, while women engaged in small scale businesses such as the sale of food stuffs. The conspicuously low level of education (more than 40% having no formal education) greatly affected the level of engagement in formal employment, considering that more than 70% of the employed had some education. From the interviews, it was clear that the fluctuations in trends of engagement in various activities always followed opportunities and the need for better earnings.

Material style of life indicators of the local communities adjacent to Mtwapa Creek

Most of the houses (68.8%) were temporary structures, with semi-permanent and permanent houses constituting only 25% and 6.2% of the total sample, respectively. A cross tabulation of mangrove usage against house type revealed a significant association between

Table 2a. Percent number of individuals associated with given material style of life items in the five villages surveyed in Mtwapa Creek. The percentages for each item are compared across the *5* villages.

	Villages				
Items	**Kashani**	**Kidutani**	**Mdengerekeni**	**Mtepeni**	**Mtomondoni**
Permanent house	0	0	0	12	88
Semi-permanent house	16	22	6	31	*25*
Temporary house	12	27	10	26	*25*
Iron sheet roof	13	20	4	27	36
Makuti roof	13	26	9	26	26
Other leaves as roof	0	33	67	0	0
Makuti wall	0	0	100	0	0
Sticks-and-mud wall	13	28	8	27	24
Stones/bricks wall	17	0	0	18	*65*
Other wall type	0	0	0	100	0
Charcoal cooking fuel	0	0	0	0	100
Firewood cooking fuel	12	*25*	9	27	27
Kerosene cooking fuel	100	0	0	0	0
Other cooking fuel types	0	0	0	0	100
Candle for lighting	83	0	0	17	0
Electricity lighting	0	0	0	0	100
Kerosene lighting	9	*25*	10	29	27
Other lighting sources	20	0	0	0	80

Bold denotes common items across the villages; italicized are items present in/used by all households

the two (χ^2 (3, N= 130) =8.74, p<0.05). Compared to the other villages in the study, Mtomondoni had the highest proportion of items perceived to be owned by the more privileged in the society, followed by Mtepeni (Table 2a). These included permanent houses, iron sheet roofing, stones/ brick walls and electrical lighting. Results from factor analysis of the *5* selected indicators showed that they all had high factor loading in the five villages, except for sticks-and-mud wall in Kidutani and Mdengerekeni (Table 2b). The extraction showed one component that explained more than 70% of the variance in each of the villages.

Table 2b. Principal component analysis of selected material style of life found in the villagessurveyed.

	Villages				
Items	**Kashani**	**Kidutani**	**Mdengerekeni**	**Mtepeni**	**Mtomondoni**
Semi-permanent house	0.933	*0.957*	0.989	-0.924	-0.741
Temporary house	0.906	*-0.957*	-0.989	0.976	*0.956*
Iron sheet roof	-0.971	*0.953*	0.989	-0.97	*-0.954*
Makuti roof	0.971	-0.92	*-0.725*	0.937	*0.954*
Sticks-and-mud wall	0.758	0.159	0.224	0.668	0.887
% of variance explained	83.027	72.198	70.16	81.398	81.422

Bold denotes high factor loading (> 0.4)

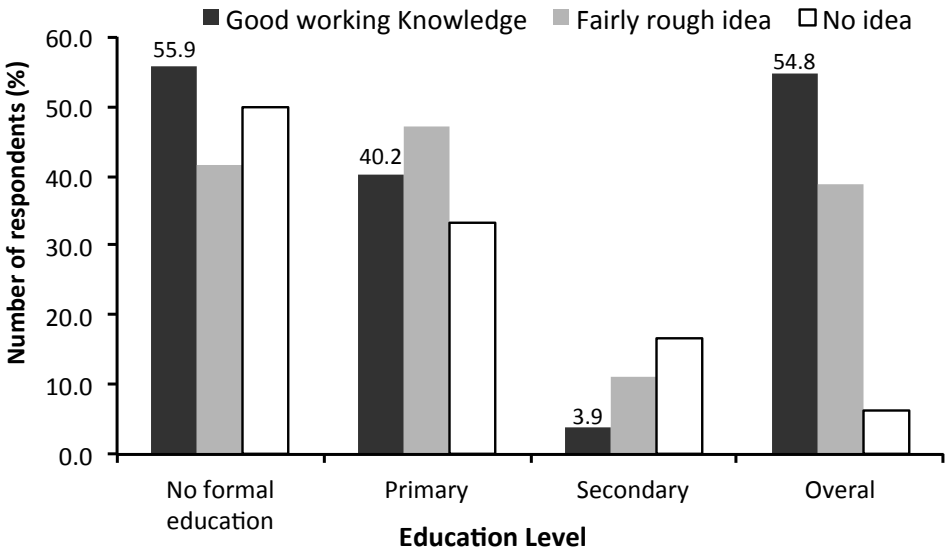

Figure 3. Knowledge of respondents on mangroves against their education level.

Households depended mainly on wood for cooking with more than 90% of the respondents using firewood in all the villages. Fuelwood collection was carried out by women, who did not wish to reveal the source of the wood. There were however no woodlots observed in the area during the survey. In addition, the results from the interviews revealed that villages which are much closer to the mangrove patches and where the terrain allowed ease of access (Kidutani, Mtomondoni and Mtepeni) had 100% dependency on firewood. These are villages within a range of 2km from the creek. Alternative sources of energy mentioned by the respondents were kerosene, palm fronds and gas.

Knowledge of mangroves and the benefits

A large percentage of those interviewed had a good working knowledge (54.8%), while 35% had a rough idea and only 4.9% had no idea about the importance of mangroves. Most respondents, irrespective of the type of house they occupied, had a fairly rough idea or good working knowledge of mangrove importance. Similarly, no association was found between age category and mangrove knowledge level (χ^2 (8, N=125) =3.6, p>0.05). However, there was a significant association between education level of respondents and knowledge on mangroves (χ^2 (9, N=130) =48.96, p<0.001). Examination of frequencies showed that of the 54.8% of those interviewed with good working knowledge, 95% either had no education or only primary level (Fig. 3). Although the number of non-native individuals (not of coastal origin) encountered during the survey was too small to make a conclusive remark, they engaged in both trading and farming and had no idea about mangroves.

Among all the benefits of mangroves known by the local community, construction was the most frequently mentioned in all five villages (Fig. 4a). Specifically, male respondents considered construction as the most important mangrove use while fuelwood was favoured by women (Fig. 4b). Additionally, observations showed that more households in temporary houses made the most use of mangrove goods in each of the categories identified. Other benefits that were considered important were mangroves as fencing poles, charcoal, mariculture sites, traditional medicine (herbs) and ecotourism. Preference in usage of mangrove products did not only vary by gender but also by age, as was established from the key informant interviews. Children engaged in simple fishing activities where they caught crabs and small fish within the tidal inlets during low tide, while adult males mostly referred to mangrove forests as a source of building materials.

Eighty-six percent of the respondents admitted that mangroves were exploited in Kilifi County, but of these, only 41% said mangroves in Mtwapa Creek were harvested. Cutting of mangrove trees for construction of houses was mentioned in all the villages. Harvesting of standing mangrove trees for charcoal production in Mtepeni was also mentioned by respondents from Mtomondoni village. Most of the charcoal was not used locally but transported out of the area by road by both middlemen and producers for sale in the nearby Mtwapa town (2km) and Mombasa (15km).

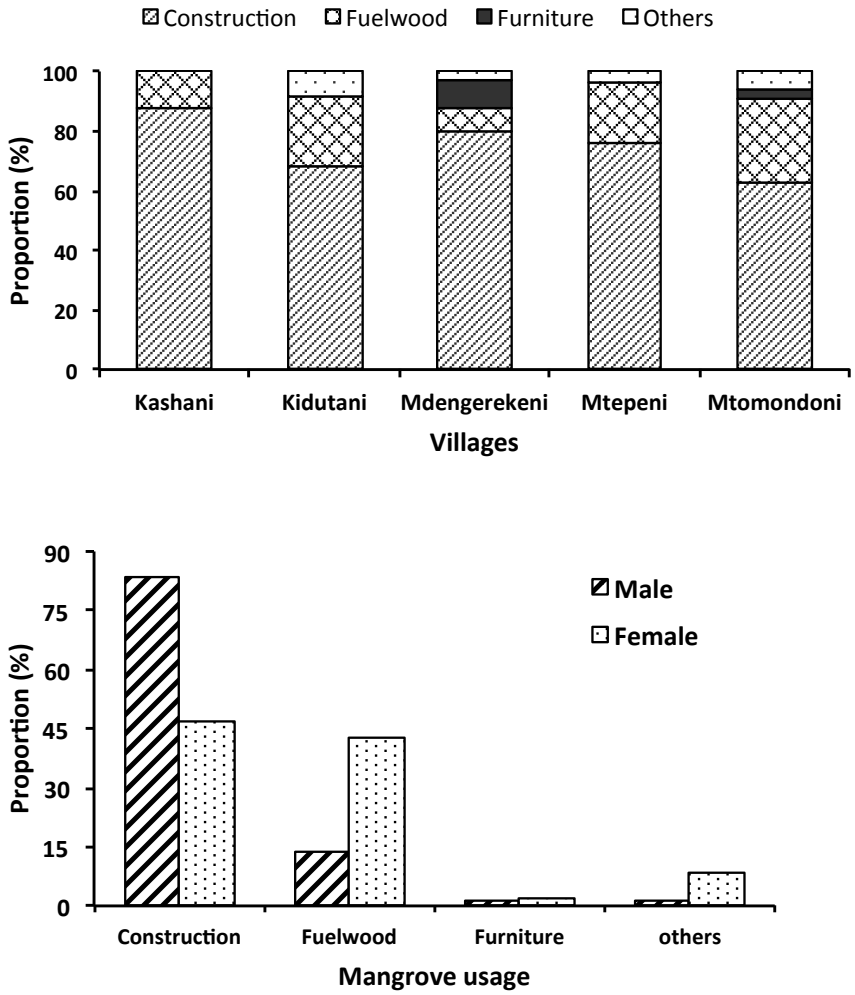

Figure 4(a). Mangrove usage patterns in the five villages surveyed around Mtwapa Creek.
(b) Cumulative preferred mangrove usage grouped by gender of the respondents.

Secondary data on mangrove harvesting revealed that illegal harvesting was a major threat for the mangroves in Kilifi County (Fig. 5). Losses due to illegal harvesting of construction poles progressively increased after the imposition of the total ban on harvesting of mangrove wood in the year 2000 (Fig. 5c), while illegal fuelwood extraction had been increasing since 1992 (Fig 5d). It should however be noted that the harvest data was for the entire Kilifi County and may only partly reflect the harvest in Mtwapa Creek. Local communities were well aware of the restrictions on access to the resource and as such, most of the harvesting in Mtwapa Creek occurred in the heart of the forest, limiting the sighting of trespassers by the forest guards. The trend was similar in the five villages with no significant association noted in the response obtained from either various age groups or education status. Local respondents blamed illegal harvesting on the high poverty levels in the area, laxity of KFS guards and corruption. Overall in Kilifi County, a complete ban was placed in the year 2000 to 2005, a period which saw a significant rise in estimated illegal extraction of mangrove poles from 348.5 to 650 scores annually, and firewood from 214.8 m^3 to 313.8 m^3 annually (Table S2 - data from KFS).

Perception of local communities on current forest status as compared to the past

More than 50% of the respondents said that the forest was depleted of poles that could be used for construction (Table 3) and that the forest had degraded over the last 10 years. A total of 38% of the respondents, however, felt that the mangrove forest status was good or recovering while another 6% felt there had been no change and thus the mangroves were very healthy. There was a significant association between gender and response on forest status (χ^2 (5, N= 100) =13.94, $p<0.05$), where most women either had no idea, or felt the forest was very healthy (Table 3).

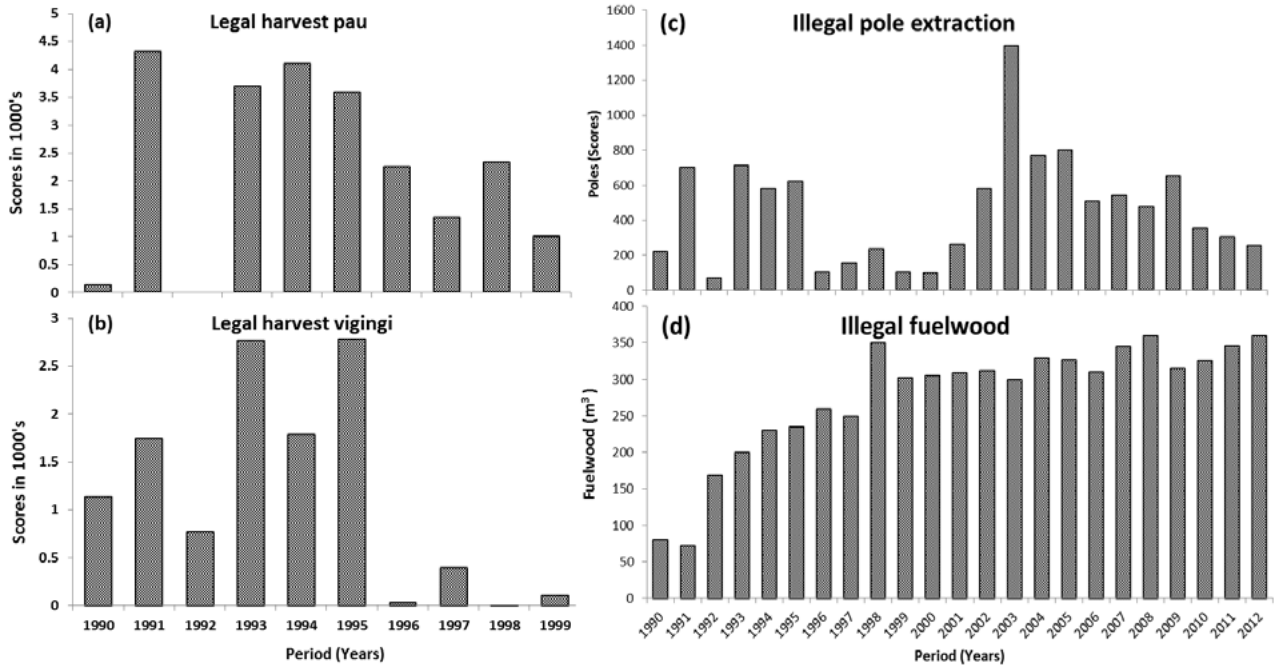

Figure 5. Legal (a, b) and illegal (c, d) mangrove wood extraction in Kilifi county. Only pau (butt diameter 4.0 – 7.4 cm) and vigingi (20 – 35 cm) were allowed to be harvested before the ban in the year 2000. Data obtained from KFS and the National Mangrove Management Plan (NMMP) working group.

Most respondents owning permanent houses felt the forest was in good condition while those with temporary houses mostly claimed that it was degraded, citing depletion of building poles (Table 3). This argument also emerged in all the focus group discussions as well as from four out of six of the key informant interviews. The focus group discussions also revealed an idea among the local communities that the *Rhizophora mucronata* (known locally as *mkoko*) in Mtwapa Creek are 'different' from those found in other areas of the coastline of Kenya, due to what they term as extremely thick bark and the crooked nature of the main stem. The Creek is occupied predominantly by *R. mucronata* with other species including *Xylocarpus granatum* (*mkomafi*) and *Avicennia marina* (*mchu*) being quite rare within the mangrove swamp.

Perceived causes of mangrove degradation

Various causes of degradation of mangroves in Mtwapa Creek were identified, with cutting pressure being mentioned by most (78.9%) of the respondents. Out of this, 76.8% believed mangroves were getting destroyed solely because of cutting, while the rest attributed degradation to a combination of exploitation and other causes. Natural tree deaths and lack or excess of rain were the other factors mentioned by 10% of the respondents in each case. The reason for *A. marina* being rare in this mangrove swamp, was for

Table 3. Perception of the local community on the present status of Mtwapa Creek mangrove forest in comparison to the past 10 years- **by gender** (n = 101) **by house type (n = 101)**.

Status	General (%)	By Gender (%)		Perception by house type (%)		
		Male	Female	Temporary	Semi-permanent	Permanent
Degraded	51.5	71.7	28.3	60.3	40.0	23.3
Recovering	13.4	46.2	53.8	8.8	24.0	11.7
Good	25.8	56.0	48.0	20.6	28.0	50.0
No change/ Very healthy	6.2	16.7	83.3	7.4	0	5.0
No idea	3.1	33.3	66.7	2.9	8.0	10.0

instance attributed to the death of the saplings of the species at an early stage, leaving the entire forest occupied predominantly by *R. mucronata*.

Only 1.4% of all the respondents mentioned the influence of land-based human activities, with farming, sewage and litter disposal being recognised in both Mtomondoni and Mdengerekeni during the focus group discussions. The terrain around the mangrove forest is generally characterized by steep slopes dotted with agricultural farms. The survey established that the local communities' farm close to the creek where they say the soil is more fertile. An analysis of the proximity of the farms showed that of the interviewed farmers, 50-70 % of the farmers had their farms within 10-100 m distance from the highest spring water mark.

Discussion

Socio-economic profile of the respondents around Mtwapa Creek

Most of the respondents in the current study were middle aged men. The variation in gender of the respondents was largely attributed to the cultural order in existence that conferred household headship (our target respondents) on the husband and not the wife. However, in certain instances the wife assumed headship in her partner's absence due to death, divorce or occupational engagements. As a result, possible gender bias effects on successive results cannot be ignored. The fact that all respondents except two belonged to the native tribal group of the area may also have a bearing on the results. This is because natives are considered to be more informed on mangrove resources because of their wide range of local traditional knowledge and experiences that are linked with their historical dependency and continuity in coastal and marine resource use and associated customary management practices (Drew, 2005). However, since the proportion of immigrants was so low, this cannot be proved from this study.

The mean household size values obtained in this survey were comparable to the county projections of 6.17 as per the 1999 population census, which is regarded as large (Kilifi District Planning Team, 2000). Considering the large household size and associated high number of dependants (Table 1), there is a greater financial burden being imposed on those who are working to support the other members (Cinner and Pollnac, 2004). Further, the income levels reported in the area were far less than those reported 10 years earlier for the villages bordering Mida Creek in a similar ecological setting further north along the Kenyan coast (Zorini *et al.*, 2004). This suggests a significant reliance of the local human community on natural resources for livelihoods due to their high poverty status (Cinner and Pollnac, 2004; Cinner *et al.*, 2009). This is further highlighted by the fact that of the 18 indicators of wealth used, house type showed the most obvious association with the responses obtained, with most houses being temporary structures, and their occupants making the most use mangrove goods.

Although there were multiple sources of livelihood identified in the Mtwapa Creek area, farming was marked as the major source of income, a case also seen among local communities around Mida Creek (Gang and Agatsiva, 1992). Like in other parts of the Kenyan coast, many households had diversified their sources of income (Cinner *et al.*, 2010), for instance farming households were also engaged in small-scale businesses. Such diversification of livelihoods is viewed as a way of increasing income to households (Cinner *et al.*, 2010). This is particularly important considering that Kenyan coastal areas have a greater percentage (62%) of the population living below the poverty line, with less than USD 1.25 per day (UNICEF, 2014), a situation replicated in Mtwapa Creek villages. It would thus be an important area of focus considering that Sustainable Development Goals (SDGs) 1 and 15 lay emphasis on poverty alleviation and environmental conservation.

High poverty levels could also be as a result of lack of diversification of earnings by the local communities which is tied to the low levels of education observed in the study, which in turn compromises engagement of individuals in formal jobs (Little *et al.*, 2009). Most respondents possess primary level as the highest level of education attained as is also the case for the Kenyan coastal region in general (Samoilys *et al.*, 2015). In fact primary school enrolment in the region increased from 63% to 84% upon the introduction of the free education system between 1999-2011 (UNICEF, 2015). Secondary education is however still wanting, as of the 60% enrolment, only 41% attend and the transition rate from primary school in 2006 was only 50% (Ngware *et al.*, 2006).

Utilization of mangrove goods and services in Mtwapa Creek

The levels of knowledge of the local community about mangroves reported in this study is in agreement with findings by Naylor and Drew (1998), who noted that local communities living adjacent to a mangrove ecosystem have adequate working knowledge of

mangroves attributed to their frequent interaction with the vegetation, almost on a daily basis for their subsistence needs. In Kenya, mangrove trees have numerous traditional uses for both subsistence and commercial users, which varies with species type (Dahdouh-Guebas *et al*., 2000). The major uses highlighted in Mtwapa Creek (construction and fuelwood) show similarity in value attached to mangrove goods and services with other communities along the Kenyan coast (e.g. in South Coast of Kenya, Rönnbäck *et al*., 2007; in Mida Creek, Dahdouh-Guebas *et al*., 2000).

Lack of woodlots in the area together with secondary data obtained from the Kenya Forest Service (KFS) showing a progressive rise in illegal harvesting of mangrove wood for fuel over the years (Fig. 5d), may be an indicator of dependence on the adjacent mangrove forest for provision of cooking fuel. Generally in Kenya, fuelwood (charcoal and firewood) provides the main source of energy, contributing 70% of energy requirements nationally, and 90% of rural households use fuelwood (Githiomi and Oduor, 2012).

Local communities may however, rank these uses differently depending on site. Consequently, identification of mangrove goods and services, knowledge about mangroves and attitudes towards their conservation can vary significantly amongst user groups based on their gender, occupation and location (Rönnbäck *et al*., 2007). Other than the role of mangrove in fisheries which was mentioned by a few respondents, under category 'others' (Fig. 5), none of the ecological roles considered as very important globally in an expert survey (Mukherjee *et al.*, 2014) were mentioned, suggesting a greater focus on the extractible benefits by the human community at local level. This also undermines the economic reasons for conserving nature as expressed by Balmford *et al*. (2002). Ecotourism was only mentioned by respondents who belonged to the conservation groups described in Okello *et al*. (2012), who are engaged in planting mangroves within the Creek.

Perception of local communities on forest status

A number of factors have been mentioned that influence how people perceive resources, including migration, education and wealth (Cinner and Pollnac, 2004). In this study, gender and wealth status greatly influenced the locals' opinion of forest status. The respondents viewed degradation based on two criteria; cover loss, and pole size and quality. The largest proportion of respondents stated that changes in the mangroves was apparent by a decline in the desired sizes or overall tree density, similar to reports by Dahdouh-Guebas *et al*. (2000). Further, the fact that most of the respondents owning temporary houses claimed that the forest was depleted of poles suitable for construction could be attributed to their heavy dependence on the forest for building poles, compared to those who had permanent houses.

Local communities rate natural mangroves higher than plantations due to the multiple goods and services they provide, except for mangrove poles which are considered less durable than those from other natural forests (Rönnbäck *et al*., 2007). This was however not the case in Mtwapa Creek where the dominant mangrove tree species (*Rhizophora mucronata* (mkoko)) is regarded by the locals as providing poles unsuitable for construction. The results from this study corroborate the findings from a structural survey conducted in 2010 by Okello *et al.* (2013). Additionally, the local respondents' argument regarding the scarcity of *X. granatum* (mkomafi) and *A. marina* (mchu), which is common in other areas along the Kenyan coast, is also in agreement with Okello *et al.* (2013).

Perceived causes and effects of mangrove degradation

The study identified various causes of mangrove degradation, with cutting pressure being singled out as the most important. Unsustainable exploitation and illegal extraction of mangrove trees, particularly for timber, building poles and firewood, has been cited as the major cause of historical decline in mangrove forests along the Kenyan coast (Dahdouh-Guebas *et al*., 2000; Kairo *et al*., 2001; Rönnbäck *et al*., 2007; Mohamed *et al*., 2009). This has seen a decline in mangrove forest cover, with the highest rate of loss being observed in the peri-urban areas (Mohamed *et al*., 2009; Bosire *et al*., 2013). However, cover change analysis between the year 2000 and 2010 suggested a 12% increase in mangrove cover (Okello, 2016), highlighting the idea of cryptic degradation, as also suggested by the local communities, which appears to be the major form of degradation in Mtwapa Creek. The fact that only *pau* and *vigingi* (Fig. 5a and b) were allowed to be harvested before the ban may have equally compromised the structural stability of the forest over time.

Apart from exploitation-related causes which are widely mentioned in the literature, the respondents attributed mangrove degradation to natural tree deaths, among other indirect causes. Such a combination of threats could lead to degradation of mangrove ecosystems and consequent loss of the ecosystem

services they provide (Dahdouh-Guebas *et al*., 2005; Bosire *et al*., 2013). The local communities believe that the forest status may get worse or better depending on the line of action taken in terms of provision of alternatives such as conservation, including favorable policies and improved participatory forest management. Attempts by local respondents living around Mtwapa Creek to counteract illegal harvesting have been quite remarkable through the formation of environmental conservation groups (Okello *et al.*, 2012). Some of the interviewees who were members of these groups, however, cite lack of support from the KFS and uncooperative non-members as factors thwarting their conservation efforts. While they live close to the mangrove area and carry out alternative livelihood activities within the forest, they do not have the power to arrest illegal harvesters who they frequently encounter. Under the new Forest Act, participatory forest management is upheld through formation of Community Forest Associations (CFAs) and has showed major successes in the involvement of local communities in conservation of mangroves in Mida Creek further north on the coast (Frank, 2014). This is however still at an infancy stage, with CFAs having only been formed in a few areas along the coast (Government of Kenya, 2017).

Land use practices, including poor farming practices in the riparian and catchment areas, damming of rivers, clearing of vegetated areas for development, and poor location of properties tend to increase instability of physical coastal formations, and hence increase soil erosion and consequent degradation of mangroves (UNEP, 2001).

Conclusion

This study shows that the local communities perceive the status of mangroves differently depending on their gender and living standards as portrayed by house type. This implies that perspectives of all stakeholders, regardless of their gender, should be integrated in the implementation of management plans. Such perspectives demonstrate the importance of local knowledge in an area where poverty levels are high and degradation of mangrove ecosystems is ongoing due to stressors such as harvesting pressure, and support the implementation of a co-management approach to mangrove conservation.

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