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Involvement, knowledge and perception in a natural reserve under participatory management: Mida Creek, Kenya

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ABSTRACT

Participatory forest management (PFM), as opposed to top down state management, is part of the decentralization process that has occurred in Africa over the past few decades. In Kenya, the process is still at its dawn with enforcing laws dating from 2005 and many pilot projects now in course. Little feedback has been given so far.

This case study evaluates, for the first time, participatory management of a Kenyan protected mangrove forest. PFM, coupled with a status of protection, is believed to be an efficient way to preserve the threatened mangrove forests.

Semi-structured interviews with local community members (people living within or next to the forest) and key-informants (people working in the forest management) were performed in order to measure three major components of participatory management: Knowledge, involvement, and perception of local communities.

Those interviews revealed a partial and overall low involvement of local communities in the formal participatory management structure. Knowledge of the policy concerning mangrove forest management was higher for the people having a job related to natural resources from the forest (e.g. fishing or tour guiding) and for people holding at least a primary level education. The former group was also more involved in the management process.

Villagers who were better informed about PFM approaches were also generally more involved in the management.

Perceptions of PFM were contrasted and many criticisms were revealed at this early stage of implementation.

These results are believed to evolve positively as the government regains trust among local communities who are given more power and wardenship on the forest.

1. Introduction

Mangroves are defined by experts as “woody plants growing normally in tropical and subtropical latitudes along the land–sea interface, bays, estuaries, lagoons, and backwaters” (Mukherjee et al., 2014).

Between 25% and 35% of the mangrove forest cover was lost during the last two decades, with higher rates occurring locally, especially in developing countries (Valiela et al., 2001; Duke et al., 2007; FAO, 2007; Bosire et al., 2014).

The recovery time of an over-exploited mangrove forest from wood extraction while left untouched should be lower than 20 years (Mukherjee et al., 2014) but in Kenya, despite the efforts of the government to protect its mangroves over the last decades, the degradation rate did not decrease. The country's mangroves have experienced a 20% loss over a period of 25 years (1985–2010), representing an annual loss of 0.74%. Extractive processes of mangrove wood was assessed to be the major cause of degradation

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(Abuodha and Kairo, 2001; Kirui et al., 2012). Land use changes due to development (roads, tourism, agriculture and aquaculture) is also a recent growing threat to the Kenyan mangrove (Rideout et al., 2013). Recently, new port development in the Lamu area which is part of Kenya's largest mangrove area, has raised international concern (UNESCO, 2015).

Traditionally, mangrove ecosystems have been sustainably managed by local populations but during the colonial and post-colonial periods, these forests came under direct control of state governments. The purpose of mangrove forests became purely commercial (wood harvesting and drainage for construction). When mangrove decline was pointed out as an important biodiversity loss, state management became mostly prohibitive and no sustainable alternatives were provided to local communities who were dependent on mangrove resources. In most cases this kind of management leads to conservation failure (Glaser and Krause, 2003; Omodei Zorini et al., 2004; Dahdouh-Guebas et al., 2006; Walters et al., 2008).

Over the last 25 years, inclusion of communities in the management of all types of forest resources has become increasingly common within a majority of African and Asian countries. In Africa, there was a clear evolution from a simple consultation of the community to a real partnership with the state in a context of devolution (Wily, 2002). Today, almost all African countries have adopted new forest laws including legal opportunity for forest-local populations to participate in forest management. Forests ownership, however, is still mostly in the hand of the state (98%) and only 0.5% is owned by local communities, against 25% both in Asia and in Latin America. Kenya, although less advanced in the participative field than other countries such as Tanzania or Uganda, has taken important steps towards the co-management process, even if the contribution of communities in decision-making power and in the access to the shared revenue accrued from the forest resources is limited (Mogoi et al., 2012).

PFM is an umbrella name for all processes and mechanisms, which enable community groups living in and around forests to take part in the management of the forest resources. It is part of a larger concept that emerged in the eighties: Community Natural Resource Management (CNRM). Community participation in forest management aims at protecting forest-based subsistence livelihoods and natural resources by incorporating the interests of resource users in a sustainable management plan. PFM is nevertheless positioning communities not only as resource users or “clients” but as populations who have rights over resources in their vicinity, and as a matter of course must have the major say in sustaining their future (Wily, 2002).

Mida Creek is located in the Kilifi county, one of the poorest counties in Kenya: In 2008, 71.4% of the population was living below the poverty level (less than US$1 a day) (Republic of Kenya, 2011).

Only a decade ago, illegal mangrove cutting was still an important source of cash for the poor and middle classes, with an estimation of around 2650 m^3 - corresponding to 37,400 US$ of building wood - harvested over a year in the Creek (Omodei Zorini et al., 2004).

The mangrove forest surrounding the Creek is partially included in the first marine protected area of Kenya, the Malindi-Watamu National Park and Reserve (MWNPR), established in 1968 (IUCN, category II). Since 1977, the mangrove forest is also part of the Arabuko-Sokoke National Park (IUCN, category II); the largest fragment of coastal forest (420 km^2) left in East Africa.

MWNPR was classified under Man and Biosphere Reserve (MAB) by the UNESCO in 1979; and as an Important Bird and Biodiversity Area (IBA) under this programme by BirdLife International's in 2001.

In the early years after the reserve gazettement, the local communities of villages around the Creek, relying strongly on mangrove resources, were excluded from management and sanctioned for resource extraction in the forest (Dahdouh-Guebas et al., 2000).

It is only in the late nineties that the Kenyan government, in collaboration with local and international environmentalist organisations started to focus on finding sustainable alternatives to mangrove use. Harvesting of mangrove resources is now allowed with a license from relevant agencies and traditional harvesting techniques only for fishery are permitted (Wildlife Conservation and Management Act, 2009).

Those initiatives emanating both from the government and communities (through the creation of conservation groups) are thought to be a major cause of mangrove regeneration. However, the effects of this new form of management on the forest and its acceptation by the whole population of the area have not been assessed yet and customary coastal management systems have been poorly described on the Kenyan coast so far (Aswani et al., 2011).

Today, many local conservation projects ally income generating activity (e.g. bee keeping and *Casuarina equisetifolia* exploitation) and mangrove trees planting, in order to sustain people's livelihood in Mida Creek (Carter and Garaway, 2014).

Tourism is often presented as an alternative to mangrove exploitation (especially eco-tourism) and even an incentive for mangrove conservation, but it is also a source of pressure on the forest, mainly for the purpose of restaurant and hotel construction (Abuodha and Kairo, 2001; Mukherjee et al., 2014). Moreover, the tourism sector in Mida Creek is highly seasonal and jobs are almost exclusively reserved to men (Carter and Garaway, 2014). It is also important to note that tourism is sensitive to severe global and local shocks. In Kenya, recent political instabilities and terrorist attacks affected seriously the positive image held by potential tourists and consequently, the flow of tourists over the last decade (Kenya National Bureau of Statistics, Republic of Kenya, 2014). Income from tourism may help to preserve the mangrove, however tourism by itself cannot be a secure alternative for local communities to excessive mangrove exploitation. It must be integrated into a global management plan.

Mida Creek, as a part of the larger Arabuko Sokoke forest, is a pilot site for participatory forest management (PFM) in Kenya (Mogoi et al., 2012). A management plan of the Mida Creek area was developed for the 2002–2027 period and funded by the Community Development Trust Fund (CDTF), a joint initiative between the EU and the Government of Kenya. In parallel, the Kenya Forest Service (KFS) wrote a participatory forest management plan for Arabuko-Sokoke and Mida Creek's forests which still has to be agreed on and signed by the local community.

The (new) Constitution of Kenya adopted in 2010 and the Forests Act (2005) emphasize the role of local communities in the management of natural resources and the importance of collaboration between state and communities.

In that framework, Mida Creek is a pilot site in Kenya for the implementation of the new participatory forest management since 2008: The principal unit of management is called a Community Forest Association (CFA) and covers a group of neighbour villages, whereas the Village Dwellers Forest Conservation Committee (VDFCC) is active at the village scale. CFA representatives communicate and exchange data with the Kenya Forest Service (KFS), the role of which is to find compromises between the community needs and the goals of the reserve.

Fig. 1 shows how the implementation of PFM coupled with the development of economic alternatives to mangrove use and income generation might lead to forest regeneration as foreseen for Mida Creek. Involvement and incentives to participate are therefore considered as crucial steps to reach conservation goals (Fig. 1). In view of the general importance for conservation of the wider

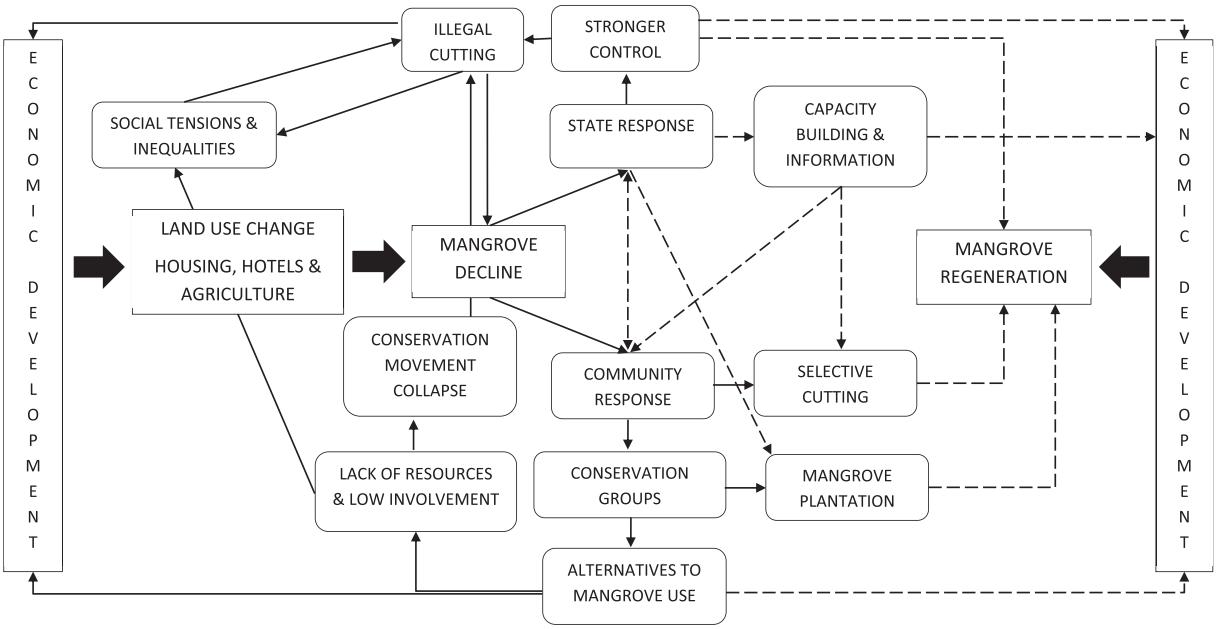

Fig. 1. General framework of mangrove management in Mida Creek (partially adapted from Dahdouh-Guebas et al., 2000). Solid black arrows show the vicious circle leading to an important decline of the mangrove forest. Dashed arrows are the expected outcomes of the new participatory forest management (PFM) leading to a virtuous circle of mangrove regeneration. Thin solid arrows are under the influence of rapid changes in local management and block arrows are more stable or depend upon larger macro-economic factors.

Arabuko-Sokoke-Watamu-Mida Creek area, the mangrove forest also deserves further scrutiny.

The main objective of this study was to evaluate and produce practical insights from the efficiency and implementation of participatory management in the mangrove forest of Mida Creek in order to determine if Participatory Forest Management has the potential to sustain a long-term mangrove regeneration approach in a natural reserve.

2. Material & methods

2.1. Study area

Mida Creek (3°22′S 39°58′E) is located 88 km North of Mombasa and 25 km South of Malindi Town, two major urban centres contributing to the Kenyan coastal economic activity (Fig. 1). In 2010, the mangrove forest was covering approximately 1650 ha (Alemayehu et al., 2014). It hosts 8 of the 9 mangrove tree species present on the Kenyan coast.

Recent biomass estimation in Mida Creek by C ohen et al. (2013) revealed a high level of forest degradation. Also, the preferential use of the dominant *Rhizophora mucronata* Lam. by local communities for construction led to a shift in species composition. The recent dominance of less appreciated *Ceriops tagal* (Perr.) C.B. Rob. in Mida Creek is thought to result from this selective logging (Dahdouh-Guebas et al., 2000; Kairo et al., 2002; Warui, 2011).

The Creek is a key spawning ground for fish species: 27 teleost species, represented mostly by juveniles, were found in the Creek (Gajdzik et al., 2014). It is also an important passage and wintering area for Palaearctic migrant waders, with high species richness: 71 aquatic bird species have been recorded on the site (Bennun and Njoroge, 1999).

There is annually 600–1000 mm of rainfall in Mida; with a typical rainy season extending from May to September.

With the short duration of its long wet season, Mida Creek belongs to the lowland livestock-Millet Zone (L5), requiring drought-resistant crops (Hoorweg et al., 2003; Alexandratos and Bruinsma, 2012).

2.2. Interviews

The interviews were carried out during the month of August 2013, in 91 homesteads from 12 villages and islands (encroachment zones) adjacent to the mangrove forest. Some of the villages interviewed had already settled a Village Dwellers Forest Conservation Committee (VDFCC): Mida and Mida-Majaoni (Majaoni VDFCC); Dabaso, Dongokundu-Kisiwani and Sita (Dabaso VDFCC); Chafisi and Magangani (Gede VDFCC).

Other villages did not have a VDFCC and were not encompassed by the Community Forest Association: Kadaina, Uyombo, Kirepwe and Matsangoni-Mikokoni (Fig. 2). An amount of

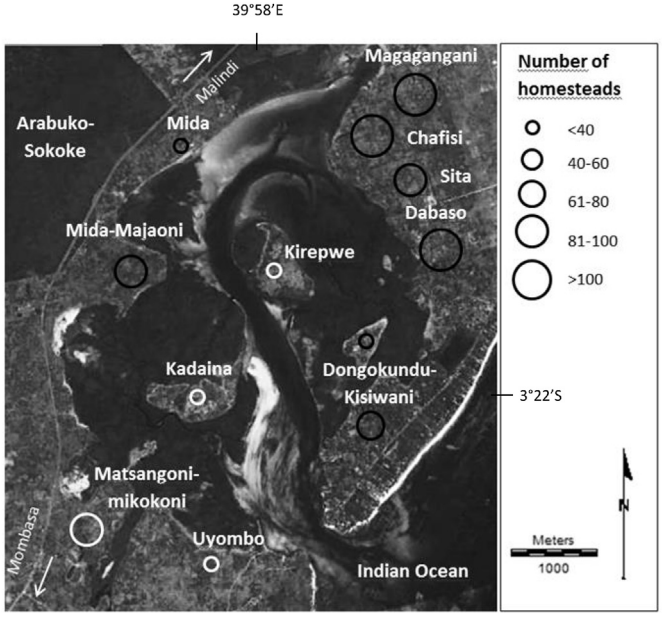

Fig. 2. Satellite image of Mida Creek with number of homesteads per village. Villages in black are part of a Village Dwellers Forest Conservation Committees (VDFCC) and villages in white are not part of a VDFCC. Imagery: 2014 Cnes/Spot, DigitalGlobe.

10–20% of the total number of households was randomly sampled to be interviewed with the help of the village leaders. This sample size allowed us to reach a good diversity of ages, occupations and education levels (from no primary school to University degree) in a reasonable amount of time (maximum 8 interviews per day)while also permitting to go beyond the questionnaire with respondents who were willing to give more insights on the topic (Baker and Edwards, 2012). Interviews were performed in local language 'kiswahili' or 'kigiriama' - according to the respondent's origin and preference - with the help of a local interpreter.

2.3. Data analysis

To analyse our interviews data, categories were developed to classify respondents' answers to open-ended questions (Annex 1). The variables selected for the statistical analysis were classified as dependent (personal answers) and independent (socio-demographic characteristics).

Pearson's χ^2-squared tests were performed to test correlations ($p < 0.05$) between variables. The nature of our dataset (frequencies) and variables (categorical) justified the use of χ^2-squared tests. Missing data or refusals to answer were not incorporated in the analysis. In total, 81 interviews were treated statistically.

Indices were extracted from the questions and a principal component analysis (PCA) was used to validate each of them. The load of an item was considered "large" if its absolute value was $\geq$0.40 and all PC with an eigenvalue >1 were considered for analysis (Table 2).

Analysis were computed on Microsoft Excel © and Statistica 10©.

2.4. Categorization and indices

When all interviews were executed, three indices were built to focus the analysis on the three central themes of the questionnaires: Policy knowledge, involvement in mangrove conservation and perception of the current mangrove management.

The "knowledge index" (KI) was built upon 4 questions of our questionnaire (Q7, 22, 23A, 23B; Annex 1 & 2). KI scores ranged between 0 and 12.

Similarly to the KI, the "involvement in conservation and management index" (ICMI) was calculated from the answers to 6 questions (Q 12, 13, 14, 24, 25; Annex 1 & 2). Personal involvement in a conservation group was taken into account, but also participation to meetings on conservation and mangrove restoration (Annex 2). Scores were ranging between 0 and 18 and classified in three categories (Table 1).

In social sciences, the concept of perception is defined as "a tendency to evaluate an entity with a certain degree of positive or negative judgement" (Eagly et al., 1989). To measure that component, a "perception index" (PI) was built upon 4 questions regarding views on different topics related to the mangrove forest management (Q7, 9B, 10, 11, 27; Annex 1 & 2).

All observations considered negative regarding the current management were given a negative score and the ones considered positive were given a positive score (Annex 4). Respondents getting a final score of 0 were considered to have either a neutral (no opinion) or a balanced (positive on some points and negative on others) view on the management of the mangrove resources.

All items (=questions) were given an equal weight so that each item as the same weight within an index (Annex 4). An item analysis was run to examine the extent to which the indices were related to the individual items that were included (Babbie, 2009).

A χ^2-squared test was applied on every index to test correlation-independent variables: Age, village of residence (VDFCC vs no-VDFCC), gender, education level, time lived in the area and main occupation ("related to mangrove resources"[2] vs "unrelated")

Each respondent was then classified in one of the three user-made categories "low, medium, expert" for KI and ICMI, and "negative, neutral/contrasted, positive" for the PI (Table 1; Annex 1).

Table 1
Scoring categories for knowledge index (KI), involvement in conservation and management index (ICMI) and perception index (PI).

	Low	**Medium**	**Expert**
KI	0–1	2–5	6–12
	Low	**Medium**	**High**
ICMI	0–4	5–8	9–18
	Negative	**Neutral or contrasted**	**Positive**
PI	(−6)–(−1)	0	1–6

Table 2
Contribution of each question (Q) used for analysis to the 4 principal components (PCs) (Eigenvalue>1). Grey cells have an absolute loading factor >0.40. * indicates that the question was selected.

	PC1	PC2	PC3	PC4
Q7	−0.55	−0.44*	0.06	−0.11
Q9B	−0.22	−0.69*	−0.04	−0.31
Q11	−0.44	−0.44*	0.23	−0.31
Q12	−0.74*	−0.01	−0.20	0.08
Q12B	−0.66*	−0.11	−0.08	0.36
Q13	−0.78*	0.10	−0.24	0.25
Q14	−0.80*	0.21	−0.23	0.16
Q22	−0.08	0.33	−0.53*	−0.05
Q23A	−0.40	0.31	0.61*	0.10
Q23B	−0.32	0.11	0.69*	0.30
Q24	−0.72*	−0.01	0.02	0.05
Q25	−0.70*	−0.04	−0.08	−0.25
Q27	0.21	−0.66*	−0.02	0.40
Eigenvalue	4.25	1.71	1.38	1.15
Variance explained (%)	30.3	12.2	9.9	8.2

3. Results

The Principal Component Analysis (PCA) revealed four components with an eigenvalue superior to 1 which explained 60.6% of the total variance (Table 2). The questions chosen to build the indices correspond well to the 3 first components whereas the 4th component is loaded mostly by one single question (Q10) (Table 2). That question relates to the perception of the management homogeneity, i.e. "Do you think there are places where the mangrove is more exploited/disturbed?" (Annex 1). Only half of the respondents were able to answer it. The other half admitted not having the required knowledge to give their opinion. Indeed, only 49% of the respondents stated they had walked within the mangrove forest within the last 6 months. Question 26 "Do you know who organizes mangrove planting event(s)?" was not included in the PCA because of the low response rate to that question. It was also realized that only a little nucleus of the population would participate to those "planting event" and very little follow-up would be observed. Actually most tress would be planted in zones subjected to strong tides and winds, where most trees would be washed ashore or remain very small.

All the questions used to build the three indices were significantly correlated to their respective index ($p < 0.05$) except Q10

[2] Licensed wood cutter, fisherman, mangrove tour guide, *mganga* (=traditional healer using plants from the forest).

Table 3
Categories of knowledge index (KI), involvement in conservation and management index (ICMI) and perception index (PI) in Mida Creek. n = 81.

	Low	**Medium**	**Expert**
KI	21	34	26
	None	**Medium**	**High**
ICMI	26	33	22
	Negative	**Neutral/contrasted**	**Positive**
PI	40	14	27

($\chi^2 = 8.74$, df = 4, p = 0.07). That question was therefore removed from the perception index (PI). The repartition of the respondents in the different categories of indices is shown on Table 3.

3.1. Knowledge on policy and management index (KI)

There was no significant variation of the knowledge index (KI) in function of village of residence, age class, gender and time of residence. Only education ($\chi2 = 6.47$, df = 2, p = 0.04) and main occupation ($\chi2 = 8.87$, df = 2, p = 0.01) were significantly correlated to the KI.

The analysis revealed that 60% of the respondents with a main occupation related to the mangrove resources[3] had an "expert" KI, against only 20% for the respondents with another activity.

Although 92% of the people interviewed acknowledged that the forest was managed by the State, only 53% would cite at least one conservation group and 32% the "community" as managers at the same level as the State. Village elders/leaders appeared as managers in only 4% of the answers and the name of a local or international NGO in 2% (Fig. 3).

Only 9% of the respondents with no education had a high KI, against 40% for the category with minimum an incomplete primary school experience.

While setting the limit of education to the holding of a primary school degree, the correlation was even clearer for high and low levels of KI ($\chi^2 = 8.71$, df = 2, p = 0.01) (Fig. 4).

3.2. Involvement in conservation and management index (ICMI)

In total, 26 interviewees (32%) were not (yet) involved in the management process according to the ICMI, independently from the fact that their village was under the formal PFM process or not.

The ICMI was correlated with the main occupation and with the gender of the respondents.

Women were significantly less involved than men, especially for the category "high" of our index with only 4% of the women group represented (against 23% for men).

Respondents with a job related to mangrove resources were significantly more involved in conservation and management than the other groups ($\chi^2 = 7.23$, df = 2, p = 0.03).

No other independent variable was correlated to the ICMI.

3.3. Perception of mangrove forest and resources management (PI)

The current interviewees' evaluation of the participatory management tended to be negative according to our index (Table 3).

The χ^2 test revealed no significant correlation between the perception index (PI) and any of the independent variables. However, respondents' village of residence (VDFCC *vs* non-VDFCC) was close to being significantly correlated with the index ($\chi^2 = 5.45$, df = 2, p = 0.06).

[3] Fishermen, mangrove tour guides, *waganga* (no licensed mangrove cutter in the sample).

Sixty-eight percent of the interviewees noticed changes in mangrove forest and resources management over the past 15 years, justifying this observation by the instauration of a controlled access to resources (47%), a more sustainable use of the resources with less use of mangrove trees (18%), a system that links the community to the authorities (15%), mangrove rehabilitation projects (13%) and the community involvement into the management process (13%).

Amongst the people who observed a change, 60% underlined the improved access to the mangrove resources as a benefit for the community but 15% considered this access to be still uneasy and 13% were still avoiding the mangrove forest by fear of being arrested or lack of feeling of ownership.

3.4. Correlation between indices

ICMI and KI were strongly correlated ($\chi^2 = 35.58$, df = 4, p < 0.00). Only one of the respondents with low KI was highly involved in conservation and management. Reciprocally, all respondents with an "expert" KI were involved in conservation, 64% of them being "highly involved" (Fig. 5).

The PI was not correlated with the two other indices. Only while looking at the perception of the community's involvement (Annex 1: Question 12) in a dichotomous way: "no participation of the community" and "participation of the community", a significant relation with the respondent's KI ($\chi^2 = 8.67$, df = 2, p < 0.00) was observed. All respondents with high KI considered that the community was at least "partially involved".

4. Discussion

The theoretical model presented in Fig. 1 was not exactly applicable to Mida Creek as the conservation objectives were not yet reached (Kairo et al., 2002; Bosire et al., 2014). This paper tried to look at the causes for low involvement that constitute one cause for failing at conservation in a participative management approach. The main discriminant factors in Mida Creek participatory management were: Gender, education and economic activity.

Gender issues in Mida Creek were already pointed out in previous studies and confirmed by our interviews, especially in the field of tourism which is highly dominated by men. In a study of 2013 in the village of Mida Majaoni, gender issues were a main reason for non-involvement in conservation projects and illiteracy was cited by local interviewees as the major weakness in conservation projects (Hamza, 2013).

The general perception of interviewees on Mida Creek's mangrove management (PI) was highly contrasted, with differences observed even between two members of the same homestead. However, the respondents with an "expert" knowledge on policy (KI) tended to perceive the whole community as involved in the management process whereas respondents with low KI tended to see the community's involvement as inexistent. This could mean that the feeling of inclusion to the management procedure can only be felt at a certain degree of policy knowledge.

Education was already proven to be a main driver for perception of resources management in the area. Sinclair et al. (2011) showed that supporting school fees for educating children from poor households adjacent to the forest improved household attitudes towards the forest and its management. Inequalities in age, gender and background has to be taken into account in the management approach in order to give all stakeholders a voice in the resulting dialogue (Reed, 2008).

The interviewed key-informants proposed different reasons to explain the negative perceptions within the population regarding the Creek's mangrove management.

Amongst those reasons are the past poor relationship with

Fig. 3. Respondents' knowledge of forest managers. Answer to the question "Who manages the forest?" n = 81.

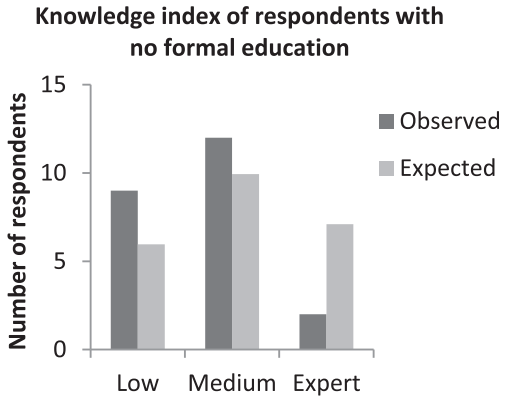

Fig. 4. Observed (dark grey) and expected (light grey) numbers of respondents "with no primary school degree" for the 3 levels of "knowledge on management and policies index" (KI). * Pearson residual absolute value > 2 (n = 22).

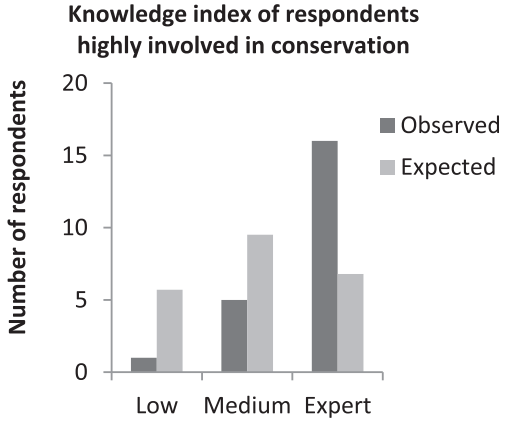

Fig. 5. Observed and expected numbers of respondents "highly involved in conservation & management" (ICMI) for the 3 levels of "knowledge on management and policies index" (KI). * Pearson residual absolute value > 2 (n = 22).

forestry staff and the lack of village-level services or income generating activities (IGA) originating from the mangrove forest. These two factors were observed in other studies evaluating the perception of communities towards protected areas' management (Hough, 1988; Holmes, 2003). Recently, interviews carried out on 11 participatory management case study sites in Spain and Portugal revealed that transparency and trust, especially between land users and government bodies, are a basis of successful participatory management. While trust is already there, participation provides further opportunities to get to know each other's concerns and take them into account (de Vente et al., 2016). In Mida Creek, the fear of deterrent measures against mangrove wood cutting (up to four years of imprisonment for illegal harvesters) was still present even amongst people who were participating actively into management and conservation projects. Without a secure right to access protected-area resources, local communities will always tend to consider the area as "lost villages resources" that are not worth caring on the long-term (Ghimire and Pimbert, 1997).

The ongoing development of alternative services from the mangrove forest such as eco-tourism, beekeeping and aquaculture is supported enthusiastically by local communities but the lack of IGA from the mangrove resources was underlined many times by the interviewees as a limiting factor to their involvement in those activities.

Our study revealed the proportion of people living officially from mangrove-related activities as being low in Mida Creek. This finding contrasts with the high dependence on mangrove observed fifteen years ago by Dahdouh-Guebas et al. (2000) and an attempt of explanation for this phenomenon is given here.

On one hand, the complex and expensive procedure to obtain mangrove exploitation permits in Kenya is an indirect cause of forest decline because it leads to illegal harvesting, even with highly coercive measures against poachers. On the other hand, the conservation groups and community-based conservation network encouraging mangrove conservation was observed to be a more efficient method to discourage illegal practices in Mida Creek (Fig. 4) and elsewhere (e.g. Walters et al., 2008; Omodei Zorini et al., 2004). There are obvious links between old conservation groups and involvement into participatory management in Mida Creek: Respondents involved in a conservation group would usually go to meetings on conservation or management as representatives of their group and, through this channel, receive information on the new participatory management implementation. Although the aim of the government was to make this information easily available to the community (Mbuvi, 2014; *pers. comm.*), it appeared from our interviews that the information may circulate only within conservation groups. There was currently no updated census report on those groups and their activities, but our results (8% of community's involvement) suggest low involvement of the community in Mida Creek's mangrove conservation projects.

Involvement of interviewees in conservation groups was much higher (97%) in a previous recent study (Hamza, 2013) than found in the present study for the same village (Mida Majaoni - 18%). This

Table 4
Challenges and proposed solutions from pilot projects of participatory forest management in Kenya and in neighbouring countries.

Pilot PFM project	Laws on PFM and forest conservation	Challenges	Solutions addressed	Reference
Ethiopia	Forest Proclamation No. 542/2007			
Chilimo		- Domination by local government officials or community elites - Lack of central government support	- Stable property-rights regime with usage rights for high-value resources - Capacity-building involving government employees and the community - Livelihood diversification, especially for poor and very poor communities.	Mohammed and Inoue 2012
Alamata		- Lack of women involvement - Lack of economic benefits	- Commercial plantations - Government subsidies	Engida and Mengistu, 2013
Kenya	Forests Act 2005			
Kakamega and Arabuko		- Lack of economic benefits	- Guidelines and clarity in the distribution of benefits	Mogoi et al., 2012
		- Lack of ownership feeling and access to livelihood resources	- Legislation on ownership	Sinclair et al., 2011
Tanzania	Forests Act 2002; Village Land Act 1999; Mangrove Management Plan 1991			
Angai		- Lack of "real" local empowerment - professionalization and privileged role of expertise knowledge - Lack of policy knowledge amongst community	- Simplification of management plans - Simple environmental standards and social codes as basis for management plans - Creating new ways of giving local understandings, values and knowledge in natural resource governance	Scheba and Mustalahti 2015
Uganda	National Forestry and Tree Planting Act 2003			
Budongo		- Limited exploitation rights for the community members - Limited income generating activities	- Monitoring of contribution from PFM arrangements to incomes generation	Turyahabwe et al., 2013

can be explained by a different sampling design, with the use of voluntary participants and focus groups in the first case while a random sampling was applied in our study.

The strong link between knowledge of policy and involvement in PFM through Community Forest Association membership was already underlined for the Kakamega National Reserve in Kenya in 2012 (Ogada, 2012). That link may seem quite logical but may easily lead to "elite capture", the process by which individuals with a superior political status due to economic, educational, ethnic, or other social characteristics take advantage of their position (Lund and Saito-Jensen, 2013). It is argued that involvement of communities could be enhanced by a better diffusion of information and simplification of the management plans, adapted to less educated people for example. Reticence and fear linked to previous governance are likely to disappear if wardenship of the local communities is respected but also if direct economic benefits are felt amongst the population involved (Reed, 2008).

Actually, the main reason given by respondents for non-participation to meetings with the forestry services in Mida Creek was that they were not invited. Some interviewees underlined the emergence of a link (usually chair of a conservation group) between government and community as another form of hierarchy and a high risk of corruption. The uneven distribution of benefits from community natural resource management was already underlined from different case studies in Kenya in the year 2000 (Kellert et al., 2000).

It is uneasy to compare PFM successes since there are no standard methods of evaluation and very few examples of comprehensive evaluation. In the past, most studies focused on evaluating the process of participation rather than its outcomes (Reed, 2008). Also important to note is that though the name PFM is used as a generic term to indicate local involvement in forest management, its specific application and bio-geographic conditions vary widely. Some challenges are however shared and pointed by researchers in the region. Table 4 compiles some challenges related to the implementation of PFM in pilot projects from Kenya and neighbouring countries. Solutions proposed by the authors are also presented (Table 4).

Changes in the management practice will eventually impact the mangrove conservation and regeneration as shown in the introduction of the present paper (Fig. 1). Some examples are given here to illustrate this impact.

In the Somone Estuary (Senegal), the regulation of wood-cutting practices combined with artificial regeneration policies has been a key parameter in the recent mangrove regeneration (Sakho et al., 2011).

This was not the case in Mida Creek and it was hypothesized that it could be related to management issues.

The aforementioned cutting restrictions in Kenya have caused many people to switch to alternative sources of wood, especially for construction and firewood, such as fast growing plantations of *Casuarina equisetifolia* L. This fast-growing species is often planted in sandy areas adjacent to the mangrove and is a good alternative to mangrove wood for construction. Unlike mangrove trees, it is easily uprooted during hurricanes if planted in monospecific fashion (Varnham, 2006) and it shows low levels of biodiversity (Gordon, 1998). When combined with other species to fill the gaps between individual tress, however, it becomes a good barrier for tsunamis (Samarakoon et al., 2013). Artificial regeneration of mangroves in Mida Creek was low and poorly monitored as underlined by a study carried out in 2013 (Frank, 2014).

An engaged decentralization process does not necessary leads to communities' involvement and sometimes even impairs it. Satisfaction regarding the decentralised management was evaluated to

be low amongst Ugandan population and conservation judged unsatisfactory (Nsita, 2003; Obua et al., 1998). In Cameroon also, decentralization in the Congo Basin forest brought up a new social stratification and the marginalization of traditional authorities (Oyono, 2005). These issues were also raised by the interviews carried out in Mida Creek and could be linked with the lack of trust in government local managers.

It is important for any kind of management plan and especially within a participatory management to make sure the work will be homogenized between villages and communities relying on the resource under management (Reed, 2008).

In Mida Creek no significant differences in involvement or knowledge were found between the villages included in the participatory management project and other villages. Some tendencies per village were however observed through homestead and key informants' interviews. For example, no interviewees living in Kirepwe Island - outside participatory management initiative - had ever participated in a meeting on conservation or natural resources management. This fact could be explained by the isolation of the island but also by the fact that no Village Dwellers Forest Conservation Committee (VDFCC) was in place there.

Kadaina Island was uninhabited till 1966 and had been strongly deteriorated through encroachment since then (Warui, 2011). Interviewees from other villages still cite Kadaina as a place where mangrove is illegally cut but. A generally positive view on the current management of the mangrove forest was, however, recorded amongst the inhabitants of Kadaina. Many active conservation groups were listed there. These facts are rather encouraging for mangrove regeneration.

5. Conclusion

The implementation of participatory forest management (PFM) in Mida Creek is not yet unequivocally reaching its set objective: Differences in policy knowledge and personal involvement are observed amongst different groups, creating some tensions within and between communities. Dissatisfactions of a majority of the local communities regarding PFM are partly due to those inequalities but also to the lack of direct results and direct profit from the new managerial approach.

It is now in the hands of the Kenyan government and local communities themselves to prove that projects of decentralization, such as the one of Mida Creek can meet their objectives. The communities' participation in the management will positively impact the mangrove conservation in Kenya only if the implementation of PFM avoids exclusion and social stratification. On the long term, PFM needs a vast majority of public support and high involvement to be sustainable. This support will only be acquired through better education and better governance.

As the ecological and economic value of Mida Creek's mangrove is today irrefutable and recognized internationally, it is also the responsibility of the international community to help local communities in settling projects that allow them to sustain their livelihood in a non-destructive fashion. Projects opportunities on payments for environmental services (PES) could be explored for carbon offset either alone, or bundled with other services such as biodiversity banking.

This study gave a first outlook and underlined some problems to be discussed by the stakeholders of the PFM pilot project in Mida Creek, which is part of an important complex setting between local livelihood and conservation. The evaluation of such a project, however, would require a longer term monitoring to be really efficient and a network of PFM projects could be put in place in order to share experiences and good practices.

If the Kenyan government wants to secure the future of its mangrove resources and services, it needs to address the weaknesses and threats of its managerial approach. Those pilot sites like Mida Creek need to be closely monitored and helped to improve future policies and management reaching to goal of sustainable resource use, in Kenya and elsewhere. The management structures already installed and initiated represent much potential and can play an exemplary role, both nationally and internationally, which requires close scrutiny and improvement on basis of the analysis.

This study underlines the importance of shared knowledge between participants and trust in order to reach the goals of participatory management. It also suggest three criteria to assess participatory management impacts on local populations: Participation, knowledge and perception of local communities. While a wide participation of local communities is essential for an effective and inclusive participatory management, perception and knowledge are the basis of a working participatory decision process in natural resources management.

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Appendix A. Supplementary data

Supplementary data related to this article can be found at http://dx.doi.org/10.1016/j.ocecoaman.2017.03.009

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