



## Transitions toward co-management: The process of marine resource management devolution in three east African countries

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### ABSTRACT

Communities are increasingly empowered with the ability and responsibility of working with national governments to make decisions about marine resources in decentralized co-management arrangements. This transition toward decentralized management represents a changing governance landscape. This paper explores the transition to decentralisation in marine resource management systems in three East African countries. The paper draws upon expert opinion and literature from both political science and linked social-ecological systems fields to guide exploration of five key governance transition concepts in each country: (1) drivers of change; (2) institutional arrangements; (3) institutional fit; (4) actor interactions; and (5) adaptive management. Key findings are that decentralized management in the region was largely donor-driven and only partly transferred power to local stakeholders. However, increased accountability created a degree of democracy in regards to natural resource governance that was not previously present. Additionally, increased local-level adaptive management has emerged in most systems and, to date, this experimental management has helped to change resource user's views from metaphysical to more scientific cause-and-effect attribution of changes to resource conditions.

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## 1. Introduction

Collaborative management of natural resources (often called co-management) emerged in the 1980s as an alternative to centralised state-led and protectionist approaches to natural resource management and an ideological shift in development agendas that considered popular participation essential for the poor to gain access to and control over resources (Cleaver, 1999; Cornwall, 2000). Co-management sought to share decision-making with people dependent on natural resources, predicated on the premise that they would be committed to sustainable resource use, could organise collectively to achieve effective resource management, and that management would be more efficient because actions and decisions were occurring at the local level. Today,

co-management encompasses various types of relationships between state and civil society in which there is decentralized transfer of power, authority, and resources to both communities and sub-national levels of government (Agrawal and Ribot, 1999; Béné et al., 2009; Crook and Manor, 1998; Ribot, 2002, 2003).

There are extensive critiques of co-management such as whether decentralized management has resulted in better outcomes for either ecosystems or societies (Béné et al., 2009; Dressler et al., 2010; Gutierrez et al., 2011). Empirical evidence that co-management systems maintain or improve the conditions of marine resources suggests mixed results (McClanahan et al., 2009; Gutierrez et al., 2011). For example, in Chile, a system of co-management that provides local fishing cooperatives with property rights has resulted in increased abundance of several nearshore fisheries species (Gelcich et al., 2008). Alternatively, McClanahan et al. (2006) found that only one out of four co-managed areas surveyed in Papua New Guinea and Indonesia had a higher biomass of targeted fish inside compared to outside; nevertheless a promising result when

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compared to the none out of four success rate of national marine parks.

Of course, success has social as well as ecological dimensions and empirical studies suggest that co-management also has a mixed record of success in achieving these (Evans et al., 2011; Wamukota et al., 2011). Although reasons for engaging in co-management can differ, and both the forms and processes involved vary enormously, it has often been considered an important mechanism for attaining the development goals of improved efficiency, good governance, equity, and poverty reduction (Béné et al., 2009; Smoke, 2003). Studies from developing countries have demonstrated examples of both negative and positive social co-management outcomes, sometimes simultaneously. For example, in the Philippines, Maliao et al. (2009) found that five out of eight social indicators of successful co-management (compliance, conflict management, control, influence, and participation) were positive when compared before and after the implementation of 16 community-based protected areas. Nevertheless, perceptions of fish abundance declined over time, and both income and access did not significantly change.

In addition to documenting the empirical outcomes of co-management, studies on the politicisation of natural resource devolution in fisheries (Béné et al., 2009; Gelcich et al., 2010) and other social-ecological systems (Batterbury and Fernando, 2006) point to the need for better understanding the unfolding social and historical processes of co-management. In this paper, we use expert knowledge and existing literature to describe the initial process of marine resource management devolution in three East African countries: Kenya, Tanzania (specifically Zanzibar), and Madagascar. These countries were chosen as focal cases for this comparison because: (1) all three have formally engaged in the process of marine resource devolution; (2) there is a substantial body of research investigating the social, institutional, and ecological aspects of marine resource use and governance to draw upon (e.g. Cinner et al., 2009c; Crona and Bodin, 2010; de la Torre-Castro and Lindstrom, 2010; Evans, 2009; McClanahan et al., 2011, 2005); and (3) they are neighbouring countries with fisheries that are relatively similar (i.e. small-scale, low technology, artisanal) compared to other countries in the region such as Seychelles, La Reunion, or Mauritius (e.g. Cinner et al., 2009b). Our comparison centres on five key themes that emerged from a workshop in Malindi, Kenya in 2010 and a synthesis of literature on governance transitions (e.g. Gelcich et al., 2006, 2010; Olsson et al., 2008). These are:

- (1) *Drivers of change*: the literature on governance transformations in social-ecological systems highlights the importance of social, ecological, and political drivers of change which can create the impetus for such governance transitions (Olsson et al., 2010, 2008). Drivers of change can include donor ideologies, political shifts, crises (e.g. in global trade or fisheries collapse), shifts in governments (e.g. the fall of an autocrat), catalytic individuals, and changes in public perceptions (Gelcich et al., 2010). These drivers can potentially create windows of opportunity to initiate change (Gelcich et al., 2010; Olsson et al., 2008).
- (2) *Institutional arrangements*: aspects of accountability, participation, and power dynamics are central to the functioning of co-management systems (Jentoft and McCay, 1995; Ribot, 2003). An adaptation of the framework of Schlager and Ostrom (1992) provides five key categories of rights. First, access and withdrawal rights refer to the right to gain access to, and harvest resources, respectively. Together, these rights indicate whether users are able to extract resources. Second, management rights refer to the ability to develop rules and regulations that restrict resource use, such as effort, gear restrictions, closed areas, etc. Third, expanding on Schlager and Ostrom's

(1992), framework, enforcement rights refer to the ability to issue and enforce sanctions for contravening rules. Fourth, exclusion rights refer to whether resource users can exclude non-members from having withdrawal rights. Fifth, transfer rights refer to whether resource users can rent or sell access to the resource to outsiders.

- (3) *Institutional fit*: considerable discussion from the linked social-ecological studies literature emphasizes the importance of institutions matching the scale of the resources being managed (e.g. Cumming et al., 2006; Kalikoski et al., 2002; Wilson, 2006). Numerous examples exist of institutions being too small or too large to effectively manage key ecosystems process. For example, Wilson (2006) describes how in the Gulf of Maine, USA, managing fish stocks at too large a scale in addressing the fine-scale aspects of ocean ecosystems, leading to sequential exploitation of fish stocks that ultimately collapsed the fishery.
- (4) *Actor interactions*: the type and nature of interactions between the different actors involved in co-management arrangements are critical to progress (McClanahan et al., 2009). Conflicts, contestation, and competition can stifle the effectiveness of co-management arrangements, particularly where resolution mechanisms are not present or not effective (Ostrom, 1990).
- (5) *Adaptive management, experimentation, and changing cognitive models*: adaptive management has been proposed as a critical component of sustainable resource use and governance (Gelcich et al., 2010; Hilborn and Sibert, 1988; Hughes et al., 2007; McCook et al., 2010). Passive adaptive management involves learning through experience. For example, monitoring, evaluating and responding to signals of environmental (or social) change. Active adaptive management involves elements of experimentation (e.g. pilot programs, experimental fishing in the marine park) in order to promote learning about the nature and dynamics of the system (Hughes et al., 2007). Engaging users in monitoring and experimentation can help to change prevailing conceptions of human-environment interactions (often referred to as mental models in the social-ecological systems literature, e.g. Folke, 2006).

The rest of the manuscript is organized as follows. First, we briefly describe each co-management system. We then use the five components described above to guide our evaluation of the transition toward co-management in each system. Based on available literature and expert knowledge, we compare and contrast key elements of each of these components. We conclude with a discussion on the progress toward fisheries co-management in the East African region.

## 2. Co-management systems

### 2.1. Kenya

In Kenya, a centralised government-led, top-down approach to marine resource management was employed until 2006, when the Ministry of Fisheries introduced Beach Management Units (BMUs) (Cinner et al., 2009c; McClanahan, 2007; McClanahan et al., 2005). Loosely defined, a BMU is an organization of fisher folk and other stakeholders that can make decisions about resource use and management. It is comprised of an "assembly" of boat owners, managers, fish processors, fish traders, local gear makers or repairers and fishing equipment dealers, and is formally led by an executive committee of stakeholders. However, decisions about registration, spatial jurisdiction of a BMU, as well as any other activities that a BMU may be engaged in rests with the Director of Fisheries.

BMUs are organized by geographically defined areas where fishers land their catch (referred to as a landing site). BMUs can comprise one or more landing sites. In most cases, to qualify for registration as a BMU, a landing site needs to have a minimum of 30 boats among other requirements (Cinner et al., 2009c). The spatial jurisdiction of a BMU extends from the coastline covering the landing sites that meet the minimum requirement of 30 boats out to the limit of 'inshore waters'. Within their area of jurisdiction, the BMUs are responsible for assisting the Ministry of Fisheries in recording landings and enforcing fisheries regulations (Cinner et al., 2009c). BMUs can also develop their own bylaws that may, for example, restrict certain gears or establish a fisheries closure, although final approval for these rests with the director of fisheries.

## 2.2. Tanzania (Zanzibar)

Zanzibar is a semi-autonomous part of the United Republic of Tanzania. The Zanzibar Department of Fisheries and Marine Resources is the responsible institution for management of Fisheries resources in Zanzibar. The (Zanzibar) Fisheries Act of 1988 regulates fishing activities. In 1994, the Zanzibar Department of Fisheries started to use a community-based approach in the management by forming Village Fisheries Committees (VFC) in all fishing villages along the coast of Zanzibar. VFCs are government-supported, community-based organizations that operate at a village level under the supervision of the village head and government fisheries officers. Each village has one VFC regardless of population size, area, number of landing sites and fishers. VFCs include all type of marine resources users including fishers, shellfish gatherers, and seaweed farmers (from both genders). Generally, the area of jurisdiction depends on size of resources, the distance covered by the local fishers, and general village boundaries. VFCs share responsibilities of enforcing and overseeing of fisheries rules and regulations with the Department of Fisheries. In addition, the VFC can create bylaws to restrict marine resource use.

## 2.3. Madagascar

There are three examples of involvement of local communities in co-managing marine and coastal resources in Madagascar associated with marine parks, marine reserves, and more generally in the devolvement of management of marine and coastal resources from the state to management transfer committees in some areas under the *Gestion Locale Sécurisée* (GELOSE). Within marine parks, which are established in Madagascar by the Madagascar National Parks and the Law on Management of Protected Areas (#2001-005 of February 11th 2003) a surveillance committee is implemented by a marine park manager in charge of the enforcement of the marine park management rules. This surveillance committee is comprised of local community members that are either elected by community members or designated by the Marine Park Manager.

Marine reserves are areas devoted to fisheries and where fisheries are closed and reopened for a certain period in the year. Marine reserves differ from marine parks in that: (1) fisheries are allowed within the reserves, contrary to marine parks, which are closed to any extractive activities; and (2) marine reserves are not devoted to tourism, as marine parks. Also, a local association manages marine reserves, referred to as *Vondron'Olona Ifotony* (VOI). The VOI Steering Committee is in charge of the management of the association as well organizing the surveillance work, enforcing the by-law when there are infringements, and managing the fisheries closure inside the marine reserve. The VOI works closely with the Ministry of Fisheries and the local authorities like the local government (Fokontany) to enforce by-laws when there

are infringements. However, the VOI area of jurisdiction does not necessarily cover the entire village fishing area and is smaller than the Fokontany and the Commune jurisdiction. The VOI Steering Committee is accountable to the association members because they are elected.

## 3. Drivers for change

The shift toward co-management of marine resources in Kenya is partially the result of a process started in the Lake Victoria fishery and occurred in the context of three international processes: (1) FAO code of conduct, which strove for a participatory approach and ecosystem-based management (FAO, 1995); (2) the DFID funded Integrated Lake Management Project that recognized the difficulties emerging from managing a trans-boundary common resource, which then attempted to harmonize the Lake Victoria Fisheries; and (3) an EU ban on fisheries exports. The devolution occurred in the context of all three, but we will illustrate the latter. Between 1997 and 1999 there were three bans on imports from Lake Victoria due to salmonella in Nile Perch (Roheim, 2005), a cholera outbreak in East Africa, and following allegations that pesticides were being used to kill Nile Perch. The bans were lifted in 2000, but these problems led to an EU development plan to help the Lake Victoria fishery meet the required health standards (Implementation of Fisheries Management Plan). Part of this process to improve health standards involved the development of BMUs, which were first introduced in 2004. Following the perceived success of Lake Victoria BMUs, a national consultation process was undertaken regarding transferring the concept to coastal areas. BMUs were introduced to the coast in 2006 and the BMU regulation was officially gazetted in 2007.

Although Tanzania was also involved in the BMU process on Lake Victoria, devolution of marine resource management in the semi-autonomous state of Zanzibar was not influenced by the BMU process and had occurred nearly a decade earlier, in 1994, when the government of Zanzibar developed VMCs. This was partially an attempt to transfer some of the high cost of enforcing fisheries regulation to communities. It also fit into other ideals for fisheries management, including improved livelihoods and reducing destructive gear use. This initiative was strengthened by a World Bank project in 2000, which included funding for patrol boats, gear exchange programs, fishing boats for communities, and training (Bishara and Zahor, 2007). VMCs were widely registered by 2002.

In Madagascar, the 1990s marked the end of the socialist regime (1975–1990) and was the starting period of economic liberalism and the Structural Adjustment Program (SAP) in which the Malagasy Government engaged with the World Bank. One of the SAP's requirements was the sustainable management of Madagascar's natural resources; hence, the National Environmental Program. This occurred in three key phases. Phase one occurred from 1992 to 1996 and implemented national parks and created the government authority (formerly ANGAP, now Madagascar National Parks), but was limited due to a lack of government to manage these parks. The Madagascar National Parks was created with the financial support from the World Bank and the German Government and the technical support from environmental NGOs, who pointed out Madagascar as one of the five biodiversity hotspots of the world (Mittermeier et al., 1998). The National Parks implementation and rapid expansion led to a backlash against national parks-type 'fortress conservation'. To solve the crisis and secure the Parks buffer zones, the National Environmental Program, which is multi-donor funded program including the World Bank, the French Government, the German Government, and others, developed the GELOSE law that became the basis for co-management.

**Table 1**

Types of power transferred by co-management arrangements (adapted from Schlager and Ostrom, 1992). MPM = marine park management. MR = marine reserve.

Type of power	Kenya BMU	Zanzibar VFC	Madagascar MPM	Madagascar MR	Madagascar GELOSE
Access/withdrawal	Yes	Yes	Yes	Yes	Yes
Limiting resource use	Yes	Yes <sup>a</sup>	Yes	Yes	Yes
Issuing/enforcing sanctions	Yes	Yes <sup>b</sup>	Yes <sup>c</sup>	Yes	Yes <sup>f</sup>
Exclusion	Yes	No <sup>c</sup>	Yes	Yes	No
Transfer (only rent)	Yes	No <sup>d</sup>	No	No	No

<sup>a</sup> Also limit camping access.<sup>b</sup> Only those that have local by laws. This is different from Kenya, where BMUs can enforce all fisheries laws.<sup>c</sup> Only through camping or landing. However, VFC can propose to Ministry of Fisheries that an individual fisher not be allowed to fish at a FMC ground.<sup>d</sup> Can change for landing or camping.<sup>e</sup> Can confiscate gear, but not arrest.<sup>f</sup> In practice, this does not occur.

Phase two ranged from 1996 to 2001, and included the transfer of management to the local level, initially for terrestrial resources, but subsequently also to mangrove management. During the second phase, the first NGO to have management responsibility of marine resources delegated to it was a foreign funded NGO named Service d'Appui a la Gestion de l'Environnement (SAGE) focused on shrimp aquaculture issues. The third phase (i.e. post-2001) saw application of the GELOSE framework to marine systems more broadly. Therefore, donor ideology was also a key driver of change for decentralized resource management in Madagascar.

#### 4. Institutional arrangements

Here, we examine three key aspects of institutional arrangements, namely power, accountability, and nested institutions. First, adapting the approach of Schlager and Ostrom (1992), we examined the power of co-management institutions in terms of the types of rights that have been devolved. We looked at whether co-management arrangements allocated five types of rights to Community-Based Organizations (CBOs) (Table 1). These include: (1) access and withdrawal rights; (2) management rights; (3) enforcement rights; (4) exclusion rights; and (5) transfer rights.

Access and withdrawal, management, and enforcement rights were present in all co-management systems (Table 1). In Kenya, the BMU chairman can enforce the national fisheries act directly without participation of the Government Fisheries Department, and BMUs can create rules through by-laws. The VFC and GELOSE systems (in Zanzibar and Madagascar, respectively) are unable to exclude outsiders from accessing resources. However, in Zanzibar, VFCs can restrict access for migrant fishers to camp, which can make it difficult for non-members to access fishing grounds. Although non-members can be excluded from accessing resources in Kenya, this right is complicated where traditional fishing grounds are shared by more than one BMU. In these cases, a

management plan must be developed that includes all BMUs that access the shared grounds. No system allowed rights to be permanently sold (such as an individually transferable quota), and only the Kenyan BMU and Zanzibar VFC system allowed for short-term access fees to be charged to non-members.

In addition to the agency to develop and implement rules, another critical part of power in the context of many co-management arrangements relates to the power to access resources to achieve mandates. We examined whether the co-management arrangements allowed CBOs to get resources for administration, equipment, enforcement, and information from various sources (Table 2). Kenya, Madagascar marine reserves, and Madagascar GELOSE systems allowed membership fees to be charged. Kenyan BMUs and Zanzibar VFC systems allowed landing fees to be charged. Although the VFCs do charge outsiders landing fees, these are the same as those charged to members; consequently, we did not include it as having transfer rights. In contrast, Kenyan BMUs charged a higher landing fee to non-members (~5% of the landing value, compared to ~1 to 3% for members). Not all BMUs charge a landing fee, however.

All systems could have income generating projects and receive in-kind support from government but, in practice, no sites received direct financial support from governments. Thus, administration, enforcement, and other expenses need to be raised through avenues such as landing fees, transfer fees, membership, and income generating projects. For Zanzibar VFCs and Madagascar Marine Parks systems, donor financial support had to be channelled through appropriate government departments. In kind support, such as equipment and training, from donors was standard across all co-management systems except for Madagascar Marine Park co-management systems and included, for example, donations of fish freezers and a depot to the Ngomeni BMU by the Kenyan Red Cross.

**Table 2**

Sources of funding for co-management systems. K = Kenya, Z = Zanzibar, MPM = marine park management, MR = marine reserve.

Sources	Kenya BMU	Zanzibar VFC	Madagascar MPM	Madagascar MR	Madagascar GELOSE
Membership	Yes <sup>b</sup>	No	No	Yes	Yes
Landing fee	Yes	Yes <sup>c</sup>	No	No	No
Transfer fee	Yes	No <sup>d</sup>	No	No	No
Income generating projects	Yes	Yes	Yes	Yes	Yes <sup>e</sup>
Donor financial grants	Yes <sup>e</sup>	No	No	Yes	Yes
Government financial support	Yes <sup>e</sup>	No	Yes	No	No
Donor in kind support <sup>a</sup>	Yes	Yes	No	Yes	Yes
Government in kind <sup>a</sup>	Yes	Yes	Yes	Yes	Yes

<sup>a</sup> In kind includes training, equipment, etc.<sup>b</sup> Subscriptions, annual membership.<sup>c</sup> At some villages 10% fee charged on landings, but only when sold at auction. If sold directly to middlemen there is no fee.<sup>d</sup> VFCs can charge outsiders a landing fee, which is the same fee that locals pay. There are no additional fees like in Kenya. However, informally VFCs sometimes stipulate that non-members sell products to certain buyers (who may pay a below market price).<sup>e</sup> In practice they do not.

A second critical part of institutional arrangements relates to accountability (Béné et al., 2009). We define accountability as a situation in which one actor is obliged to inform another actor about the former's actions and decisions, to justify them, and in the case of misconduct, to suffer punishment. Béné et al. (2009) find that in West Africa, the flow of accountability remains 'upwards' within state institutions, rather than being 'downwardly' accountable to local people. Examples of downward and upward accountability mechanisms include election or political appointment, respectively. While each country previously had some form of downward accountability through the existence of locally elected local government, in terms of resource management, the relevant government departments tended to be characterised by upward accountability. For example, in Kenya, prior to the BMUs development, there was little downward accountability, which may have been partially responsible for key challenges encountered and failures in establishing the Diani-Chale MPA in the 1990s (Evans, 2009; McClanahan, 2007).

With the transition to co-management, power has been devolved to local Community-Based Organizations (CBOs) that have some element of downward accountability to the resource users in all three countries. For example, resource users elect the leaders of the CBOs to which power has been devolved to, meaning these leaders are downwardly accountable to these constituents. This has created a degree of democracy in the system that was not previously present. The exception to this general downward accountability is the Madagascar marine park surveillance committees, which are not accountable to their community, but rather to the Park Manager.

Considerable research on common property management also suggests that institutions that are nested within larger governance structures are more likely to be successful (Ostrom, 1990), and that functional redundancy between different institutions can help to maintain key governance roles when problems in one branch arise. Our research in Kenya provides some cautionary support for this regarding the enforcement of regulations banning beach seine nets. In general, the Fisheries Department is in charge of enforcing this law, but inadequate national resources make this nearly impossible. Beach seine nets are, however, effectively excluded where there is enforcement by local communities and other government agencies, such as the Kenya Wildlife Service (McClanahan, 2007). Importantly, enforcement of beach seine prohibitions is very localized and there is not effective enforcement everywhere there is functional redundancy.

## 5. Institutional fit

Co-management systems in our three case study countries tended to manage resources on the scale of square kilometres. For example, Kenyan BMUs are responsible for areas ranging from 0.93 km<sup>2</sup> to 61 km<sup>2</sup>. Comparative ecological research in this region and others shows that some species respond to management at this scale (Babcock et al., 2010; McClanahan et al., 2008, 2007). For example, the biomass of targeted reef fishes has been shown to increase even in small protected areas (McClanahan et al., 2007, 2006), but certain types of fishes respond differently, presumably based on their life history characteristics (McClanahan et al., 2007). These areas may, however, be too small to fully restore top-level predators and associated ecosystem processes, such as predation (McClanahan, 2000; Sandin et al., 2008).

In the social-ecological systems literature, however, less research has focused on the importance of matching institutions to the scales at which societies organize. There are two interrelated aspects of this worth highlighting: group size and existing social groupings.

Theoretical, empirical, and game experimental research emphasizes the importance of group size in collective action. For example, Agrawal and Goyal (2001) found that medium-sized groups (between 60 and 100 households involved) are more likely than smaller or larger groups to provide third-party monitoring. Group sizes between the different co-management systems vary considerably, ranging from a single village to several villages. Only the Kenyan system has a minimum group size, but this is based on boats, rather than on members. Officially, 30 boats are required to make up a BMU. This is an artefact of the legislation's origins in the Lake Victoria fishery, where nearly all fishers utilize boats. However the coastal context is very different and many fishers use nets without boats or can spearfish from shore. This has resulted in multiple landing sites, some with histories of antagonism, being grouped together to form a BMU. However, the Fisheries Department have designated BMUs with less than this number of boats on a case-by-case basis. Examples of this include Ozi BMU near the Tana River delta. Furthermore, there has already been a proposal to change this rule to fit the coastal context. A study of 13 Kenyan BMUs found that the number of households in each BMU ranged from 41 to 700 (Cinner, unpublished data).

New co-management institutions can also be examined with regards to the 'fit' with existing resource management institutions (Aswani et al., 2011; Aswani and Furusawa, 2007). Where co-management reforms are implemented with little consideration of existing local institutions they can undermine effective resource management (Gelcich et al., 2006). In Kenya, traditional marine resource management institutions had largely eroded prior to the introduction of BMUs (McClanahan et al., 1997), but many remain intact in Madagascar (Cinner, 2007).

There may be benefits in matching institutions to existing geographically oriented social groupings, such as landing sites, which may, divide themselves along ethnic, political, or ideological lines. For example, landing sites are often divided by ethnicity, practices they readily accept (such as the use of illegal gears like beach seine nets), whether they allow migrant fishers, the presence of traditional management, etc. (McClanahan et al., unpublished data). In developing pilot BMUs, the Kenya Fisheries Department initially grouped together conflicting landing sites, for example Gazi (which had migrant fishers and readily accepted illegal beach seine nets) and Chale (which used traditional management to restrict gears). Also, when landing sites are separated by different ethnicities, conflicts can arise due to cultural issues about being ruled by other socio-economic groups or ethnicities. After piloting, several BMUs have been separated back into their constituent landing sites. On one hand this makes local-level management easier, but there is also a danger that this can legitimize and reinforce ethnic tension. The Kenyan Fisheries Department has tried to deal with this type of ethnic polarization through joint management plans and MOUs between BMUs, which give polarized landing sites an arena to work toward solutions associated with joint BMU membership. Although still in early stages, these formal recognitions seem to help reduce conflicts.

In Madagascar, GELOSE arrangements generally happen at village-scale, so there are fewer reported incidents of inter-village issues than in Kenya. Tanzania has history of trying to erase tribalism and ethnic identities (Yeager, 1982). Generally, VFCs are at village scale. However, VFCs can cover different political constituencies when they do cover >1 landing site.

In all three countries, the scale of social organization is often considerably smaller than ecological processes being managed, thus there are trade-offs between matching institutions to social and to ecological scales. Some co-management projects attempt to co-manage at larger scales. For example, the Menai Bay Conservation Area covers 19 VFCs. Importantly, there are

trade-offs between managing at the different scales required for key social versus key ecological processes. Increasing the scale of management to manage large and migratory species and associated large-scale ecosystem processes means increased group size, inclusion of potentially conflicting groups, and other social processes that challenge collective action (Agrawal and Goyal, 2001; Ostrom, 1990).

## 6. Actor interactions

Numerous conflicts exist among user groups in the three study countries. Examples of conflicts between different stakeholders in the fisheries sector include conflicts between: (1) tourist boat operators and fishers; (2) fishers using different gear types; (3) local and migrant fishers; (4) landing sites with shared fishing grounds; (5) fishers and hotels or other property owners over access to traditional landing sites; (6) fishers and marine parks; and (7) fishers and local municipality development projects that can affect access to the resource. Cinner et al. (2009c) found that both the GELOSE and BMU frameworks had conflict resolution mechanisms to address conflicts between key user groups.

In some instances, conflicts can lead to adaptations in legislation. For example, the Mombasa Park and Reserve was established by presidential decree and put into law by legislation. The result was resistance from the local boatmen and fishers but for different reasons. The boatmen had been ferrying tourists without paying park fees and were concerned that this fee would reduce their business and income. The fishers were concerned about the lost fishing grounds and after numerous conflicts fisher numbers were reduced (McClanahan and Mangi, 2000). The boatmen's projected loss of profits was not realized and they eventually became allies of the park service soon after the initial conflicts. However the fishers' maintained resistance that resulted in reducing the closure size from 10 km<sup>2</sup> to 6 km<sup>2</sup> and eliminating beach seines in the reserve area up to 3 km from the park's southern border. These changes have been stable and there is good evidence for reduced conflicts and, eventually, increasing incomes of the remaining fishers (McClanahan, 2010).

In other instances, conflicts and contestation can be so intense as to limit the capacity of governments to enact national legislation. For example, the Diani-Chale Reserve was gazetted in order to reduce conflict in the second largest tourism area in Kenya and was assisted by Dutch aid (McClanahan et al., 2005; Evans, 2009). The parks service attempted some community sensitization during the early stages but did not fully engage the resource use community – favouring the tourism community, which led to irreconcilable conflicts at the time of implementation. Here, the conflicts became quickly violent and were probably more difficult to resolve as the affected group was from one largely historical marginalized ethnicity (Digo), the environment was more rural and lacked job opportunities, and the tourism investors were largely not from the area (McClanahan et al., 2005; Evans, 2009). There was also intense political interference and competition from the Kwale county council that wanted to share the Park entry fee with Kenya Wildlife Service (KWS). Once it became obvious that the government would not succeed, the reserve implementation was shelved in 2003 by a letter to local fisheries and community leaders.

There can also be considerable conflicts between different sectors governing the fisheries. An example of sectoral conflict is illustrated from challenges between the Fisheries Department and KWS over fishing activities within the marine reserves. This conflict results from interpretation of responsibility where there is functional redundancy in joint jurisdictions. An example is the use of beach seines that are illegal and are completely restricted in the Mpunguti marine reserve but are commonly used in the rest of the

marine reserves. The failure of the Fisheries Department to enforce beach seine restrictions led to KWS confiscating these nets in the Mombasa and Malindi-Watamu marine reserves. These efforts have not been long lasting partly because of the lack of a joint mechanism despite numerous meetings on the issue between these sectors to resolve this management challenge (Anonymous, 2005).

Likewise, in Madagascar, sectoral conflicts may hamper effective co-management. Conflicts exist between the Ministry of Fisheries and the Ministry of Environment over co-management of mangroves. Community-based organizations (under GELOSE framework) were set up to manage mangroves under the Forestry Department (Ministry of the Environment), but there has been pressure to have these CBOs under the Ministry of Fisheries because of the crucial nursery role of mangroves. Conflicts arise because donors provide direct support to the Ministry of the Environment but not to Fisheries, but the latter is often burdened with enforcement responsibilities. Sectoral conflicts between government agencies may be more difficult to resolve, so long as jurisdictions and responsibilities remain unclearly defined. Of course, interactions between actors are not always antagonistic and several examples exist of complementary arrangements, particularly when there are government, private, and public sector involvement. These include, for example, the ring net task force in Kenya (Anonymous, 2005), fish catch monitoring systems between NGOs and the Fisheries Department, and collaborations between private parks and Fisheries Department in Zanzibar tackling illegal gear use.

In addition to conflicts, considerable research has highlighted the importance of social networks as a critical part of actor interactions (Crona and Bodin, 2010; Folke, 2006; Folke et al., 2005; Gelcich et al., 2010; Olsson et al., 2010). Social networks allow for informal ties at various scales to be utilized and emerging research examines the diversity and strength of networks that arise at various scales in co-management institutions (Crona and Bodin, 2010). These types of linkages are generally seen as good thing, but there are costs associated with interactions, similar to transaction costs in economics. These can include, for example meeting costs, salary costs, and time devoted to maintaining networks. Key questions remain whether these costs are greater than the benefits. These types of actor interactions, although potentially important, are beyond the scope of this article.

## 7. Adaptive management and changing mental models

Adaptive management can be an important part of changing people's perceptions about the condition of marine resources and the drivers of these changes (Folke et al., 2005; Hughes et al., 2007; Olsson et al., 2010). In particular, active experimentation (for example closing fishing grounds) in combination with effective and transparent communication can challenge existing paradigms about human–environment interactions (Hughes et al., 2007).

In all three systems, monitoring, experimentation and other aspects of adaptive management have helped change peoples' mental models (i.e. peoples thought process about how something works) from metaphysical explanations of environmental change toward perceptions of human agency. For example, in the southwest of Madagascar, experience with a rotational closure for octopus harvesting has contributed to changing mental models about the role of humans as causal agents in marine systems (Cinner et al., 2009c; Langley et al., 2006). Initially the discourse about octopus fishing was dominated by metaphysical explanations about yields. After experimentation with the rotational closure, people now believe that their actions can influence octopus abundance and catch rates.

Likewise, in Kenya annual communication of fish catch data along the Kenyan coast has helped shape debates about resource use and management. In 1995, an international NGO, the Wildlife Conservation Society, began a series of meetings that evolved into an informal “Fisheries Forum” that involved the NGO, fisheries leaders, and the national fisheries department. Results of fish catch data from multiple landing sites were shown at the forum meetings and the basis for discussions of their causes and possible rectification. In the early stages fishers attributed the declines to metaphysical causes but also the use of seine nets or offshore trawlers often by migrant or foreign fishers. This led to experimental co-management, which attempted to eliminate seine nets beginning in 2001 using a mix of local coercion and government enforcement. During the early stages, some landing sites restricted the use of seine nets (McClanahan and Mangi, 2004). The reduction and elimination of seine nets led to increased catch in some of the compliant landing sites. This then led to improved compliance by 2004, as it became broadly recognized that seine net use was the cause of the declining catches. Subsequent monitoring of the catch has shown a continuing increase in fish catch metrics and income (McClanahan, 2010). The result was increasing, although not universal support for standard fisheries management regulations and less reliance on metaphysical explanations for declining catches.

In Madagascar, the GELOSE systems have key elements of adaptive management, but lack aspects of flexibility required for other aspects of adaptive management (Cinner et al., 2009a). In particular, GELOSE systems are contracts that are re-assessed after 3 years based on assessments by both government departments and independent assessors, which is donor funded. This has resulted in several GELOSE systems changing key practices (Belvaux and Rabearisoa, 2006). For example, after a positive assessment, the CBO co-managing the Ifaty MPA “Jardin des Roses” in South West was expanded to incorporate several other villages and expand the MPA to the whole Bay of Ranobe. Assessment criteria is focused on: (1) management and governance aspects (CBO legal creation, rule enforcement, etc.); (2) social aspects like community representativeness inside the CBO, conflicts resolutions through the CBO, etc.; (3) economic and environmental impacts of the CBO management (Belvaux and Rabearisoa, 2006; Resolve-PCP-IRD, 2005). When the assessments identify unsuccessful outcomes, the common recommendation is to make and enforce stricter regulations.

## 8. Conclusion

Across these three countries, the transition toward co-management share similar properties. In all cases, the move toward co-management was driven largely by donor ideology and subsequent support. Likewise transfer of power created a degree of democracy in resource management that was not previously present, but in many cases, accountability remained upward to national governments, rather than downward to local actors. The scale at which co-management has occurred in the western Indian Ocean is large enough that some but not all key ecosystem properties can potentially respond to more local management. For example, the biomass of target reef fishes has been shown, in some cases, to change when managed at this scale (McClanahan et al., 2007, 2011).

Efforts to create new social groupings to manage resources encountered problems, particularly in circumstances where adjacent landing sites had histories of conflict. Conflicts were not only among resource users, but also among the government agencies that were contesting power, access, and resources. In some instances, these conflicts provided the basis for adaptive changes to regulations. In all countries, experimentation with different forms of management provided a forum that contributed

to changing people's ideas about human–environment interactions. Comparison of the transitions toward co-management revealed numerous conflicts and problems, but we found that they formed a basis for positive changes toward increased democracy, environmental education, and adaptive management. Fisheries co-management has the potential to produce positive outcomes for societies and ecosystems, but successful co-management will likely require investing in institutions and building leadership capacity at local scales (Evans et al., 2011; Gutierrez et al., 2011).

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