Ocean & Coastal Management 135 (2017) 1–10

Contents lists available at ScienceDirect

Ocean & Coastal Management

journal homepage: www.elsevier.com/locate/ocecoaman

Developing locally managed marine areas: Lessons learnt from Kenya

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ARTICLE INFO

Article history:
Received 13 May 2016
Received in revised form
3 October 2016
Accepted 21 October 2016

Keywords:
LMMA
Fishing community
Stakeholders
Conservation

ABSTRACT

Coastal communities in Kenya are increasingly adopting Locally Managed Marine Areas (LMMAs) and by 2015, 24 had been established. Coastal communities perceive the objectives of these LMMAs are to primarily conserve fisheries and marine resources and secure alternative sources of income. In this study we examined if there are generic approaches in how these LMMAs were established, that can be used for developing national guidelines as well as have application to other locations in the western Indian Ocean region. The study involved a literature review of all documents available on the LMMAs and key informant interviews.

We found LMMAs in Kenya go through five phases to become fully established and operational: i) Conceptualisation, ii) Inception, iii) Implementation, iv) Monitoring and management; and v) Ongoing Adaptive Management. We defined each stage by the activities that are taking place which determine how far a LMMA has reached in its development. The final phase is when a LMMA exists sustainably in a continuous learning process. Out of 19 LMMAs assessed, four had reached the fifth stage of 'Ongoing Adaptive Management' though not all elements of this stage were fully operational.

The Kenyan model differs from the widely known Pacific model of four phases due to an additional initial 'Conceptualisation' phase. Our results illustrate the need for full acceptance of the LMMA concept by stakeholders before progressing to the 'Inception phase.' When this step was missed many LMMAs stalled due to unaddressed training needs, incomplete involvement of stakeholders and lack of financial resources, management and operational structures. These five phases provide a useful guide for communities and other stakeholders to follow when developing LMMAs, or for those that are established and need guidance on their operations.

Common factors that we found associated with the development of LMMAs were informed and committed community members, past training in community based marine resource management, a supportive legal framework, external funding and opportunities for sharing LMMA information. The occurrence of an exchange visit to an existing LMMA was invariably the trigger for a community to establish their own LMMA. Weaknesses were seen in poor enforcement on the water and inadequate ongoing education and training. Further there was very little understanding of the costs of establishing and running a LMMA, therefore long term financial sustainability was problematic. Thus, although the rapid increase in the number of LMMAs in Kenya is a conservation success, their effectiveness will be thwarted if enforcement and financial management are not addressed.

1. Introduction

Marine conservation has moved strongly towards co-management in recent years, in contrast to the top-down approach to natural resource management applied in the past (Cinner et al., 2012; Rocliffe et al., 2014). This move was seen in marine conservation in the Pacific in the 1990s (Govan et al., 2009).

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http://dx.doi.org/10.1016/j.ocecoaman.2016.10.013
0964-5691/

It builds on recognition of the power and rights of local fishing communities to manage their marine resources and this is typically effected through Locally Managed Marine Areas (LMMAs) (Green et al., 2009; Rocliffe et al., 2014). As a result, the South Pacific has experienced one of the greatest increases in number of LMMAs, now involving over 500 communities in 15 countries (Govan et al., 2009). The Pacific LMMAs are characterized by strong government investment in community based fisheries management, support by non-governmental organisations, adoption of traditional forms of management, support by local social networks and positive perception by community members (Russ and Alcala, 1999; Govan et al., 2009; Mills et al., 2011).

Kenya has seen a rapid rise in the number of LMMAs since 2010. The first were mangrove board walks declared in the 1990s, in association with mangrove re-planting schemes. The first coral reef based LMMA, Kuruwitu, just north of Mombasa, was established in 2006. By 2008 a further two mangrove board walks and two coral reef based LMMAs were established and by 2011 there were 13 coral reef and five mangrove LMMAs several of which on the south coast were supported by Flora and Fauna International (FFI), with the East African Wildlife Society (EAWLS) (Abunge, 2011; Maina et al., 2011).

Coral reef based LMMAs in Kenya have been created for several reasons but the initial impetus is likely to have been a cross visit to Tanzania in 2004. During the early stages of the establishment of Kuruwitu, the East African Wildlife Society (EAWLS) arranged an exchange visit for Kuruwitu fishers to go to Tanga in Northern Tanzania, to see the Collaborative Management Areas (CMAs) that had been set up by the Tanga Coastal Zone Conservation and Development Programme (TCZCDP); (Wells et al., 2007). The objective of the visit was to give Kuruwitu fishers who had expressed interest in establishing a LMMA a first-hand experience of their operation and to discuss with the Tanzanian fishers their experiences. This exchange visit culminated in Kuruwitu's establishment. Other reasons for their uptake in Kenya span fishers' concerns over degraded fishing areas and dwindling stocks, increased involvement of communities in natural resource management by government (Cinner et al., 2012), increased use of illegal and destructive fishing methods (pers. obs.) and perception by some resource users that government marine parks provide little economic benefits to themselves or to their local communities (Malleret-King, 2001; Davies, 2002; Wanyonyi et al., 2008).

Not all LMMAs in Kenya are fully functional and others face challenges. For example, there is no clarity on the procedures to be followed in designating a LMMA (Maina et al., 2011) and some proposed LMMA sites lie within National Marine Reserves which are under the jurisdiction of the Kenya Wildlife Service (KWS) and, as yet, there is no experience in operating a LMMA within an existing government marine protected area. The current fisheries co-management structure used in Kenya is the Beach Management Unit (BMU) through which community rights over resources have been legally established (GoK, 2007). However, there are many pieces of legislation that govern the management of the coastal and marine environment in Kenya (Samoilys et al., 2011) making a legal anchor for LMMAs complex. In response to this, a task force was established to develop legal guidelines for LMMAs (Odote et al., 2015). The lack of legal clarity and limited management and financial supporting mechanisms for LMMAs are likely to be reasons for why some LMMAs have been established only to stall within a short time. Coastal and marine stakeholders are demanding guidance on LMMAs as they see them as a viable solution to declining catch rates, to eliminating destructive fishing gears, to combat the negative effects of climate change and limited fishing controls (Samoilys et al, in press; McClanahan et al., 2016), conditions that are widespread globally (Allison et al., 2009; Gutiérrez et al., 2011; Cinner et al., 2012).

In response to this history, the objectives of this study were to examine if there are generic approaches in how LMMAs have become established in Kenya, to identify key challenges and successes and to provide information that could be useful for developing national guidelines as well as be applied more broadly to LMMAs in the western Indian Ocean (WIO) region.

2. Methods

In this study we documented all LMMAs in Kenya and, depending on the information available, assessed their stage of development and effectiveness. We use LMMA as a global generic term for community or locally managed areas in the marine environment which have some form of protection or regulation. Many names are used in Kenya to refer to these areas, including community conservation area (CCA), *tengefu* (Kiswahili for 'set aside', McClanahan et al., 2016) and community conservancies, often relating to the legislation used to declare them or to the various actors who have promoted them (Table 1; Odote et al., 2015). Govan et al. (2009) working in the Pacific defined a LMMA as *"an area of nearshore waters and coastal resources that is largely or wholly managed at a local level by the coastal communities, land-owning groups, partner organisations, and/or collaborative government representatives who reside or are based in the immediate area."*

We used a combination of a desk top review of published and grey literature with key stakeholders, to determine the path to establishment of LMMAs, their successes and their challenges. There was limited published information on the history of the different LMMAs in Kenya (Harrison and Laizer, 2009; Karisa et al., 2010; Kuruwitu Conservation and Welfare Association, 2011; Maina et al., 2011; Lamprey et al., 2012; Mwaura, 2013) so we also examined draft management plans that were available (Kuruwitu, Kanamai-Mradi, Kibuyuni, Vanga), proceedings of the Darwin Initiative Final workshop held by East African Wildlife Society/Flora & Fauna International (EAWLS/FFI) in 2012, student theses (Yusuf, 2011; Ogada, 2013) and government legislation, particularly the Fisheries Act (GOK, 2007) and the Environmental Management and Coordination Act (GOK, 1999).

Out of the 24 LMMAs found in Kenya, five were Mangrove Board Walks and were therefore not reviewed further. Of the 19 LMMAs that included coral reef areas, 10 were interviewed, 5 were too new (within 1 year of establishment) to fully assess their effectiveness

Table 1
Generic and legal names used for LMMAs in Kenya (after Odote et al., 2015).

Generic terms	Legal term	Legislation	Agency
Locally Managed Marine Area (LMMA) Community Conservation Area (CCA)	Co-management area	Fisheries Act Cap 378; Fisheries (Beach Management Unit) regulations 2007	State Department of Fisheries (SDF)
Tengefu/vilindo vya wenyeji (Kiswahili) Community reserves	Sanctuary Marine Protected Area Wildlife Conservancy	Wildlife Management and Conservation Act 2013	Kenya Wildlife Service (KWS)
Community conservancies Indigenous Protected Areas Biocultural heritage sites	Protected coastal zone	Environmental Management and Coordination Act 1999, National Environment Management Authority (NEMA)	

Table 2
Questionnaire used to assess LMMAs through key informant interviews.

Phase 1 – Conceptualisation
What was the origin of the initial interest for the LMMA?
Did the community and key stakeholders understand the LMMA process?
Was the general area for the LMMA identified?
Who were the stakeholders?
Were champions for the LMMA process during this phase identified?
Who financed this stage?
What was the time frame to reach this stage?
Did the stakeholders endorse the LMMA idea with a signed agreement?
What were the challenges and successes faced?
Phase 2 – Inception
Was the LMMA concept understood?
Were the goals and objectives of the LMMA defined and understood by all?
Were roles and responsibilities of stakeholders defined, and understood by all?
Was the specific LMMA area identified agreed on by stakeholders?
Was the exact location of the LMMA, size and boundaries known to stakeholders before implementation?
Was an EIA undertaken?
Did preparation of a management plan by key stakeholders begin?
Was the process participatory?
Was an education and awareness plan prepared?
Was a financial plan to manage the LMMA put in place?
Was a needs assessment for training and resources undertaken?
Phase 3 – Implementation
Was the draft management plan completed and adopted?
Was the LMMA established with buoys?
Was a monitoring plan drafted?
Was an enforcement patrol plan developed?
What were the enforcement and compliance methods used?
Which management interventions were adopted by the LMMA?
Was there a signed agreement by community on establishment of the LMMA?
Was the legal basis of the LMMA formalized or at least initiated?
Were members trained on how to manage the LMMA?
Were there challenges of land ownership etc?
What is the estimated cost of implementing this phase?
Phase 4 – Monitoring and management
Has the community adopted the monitoring plan?
Is an ecological and socio-economic assessments undertaken annually in a participatory manner?
Are the ecological resources/fisheries/habitats in a better condition?
Was an enforcement patrol plan adopted?
Was enforcement patrol effective?
Have the communities' skills been improved?
Are the boundaries maintained?
Are available equipment used efficiently for management?
Is the LMMA self-sustaining?
What is the estimated cost of implementing this phase?
Phase 5 – Ongoing Adaptive Management
Has the LMMA management plan been reviewed?
Is the information garnered from the monitoring used to improve management?
Is training and capacity building reviewed to ensure management improved?
Is the financial plan reviewed regularly to guide management?
Is the marketing and awareness plan reviewed regularly?
Are lessons learned documented and shared?
What organisations/individuals help ongoing adaptive management?
What is the estimated cost of implementing this phase?
What does it cost to run the LMMA per annum/month?

and 4 had minimal documentation.

The structured interviews (Table 2) for 10 LMMAs were carried out face to face with key informants: chairpersons and organising secretaries of Beach Management Units (BMU), community leaders and patrons of BMUs. The individuals were selected based on their presence during establishment or operations of LMMAs, so former leaders were also interviewed. Interviews were conducted in: Kuruwitu, Bureni, Kiweni, Kibuyuni, Wasini, Jimbo, Vanga, Kanamai-Mradi, Shimoni and Nyari-Kikadini. To structure the interview questions, we used our initial findings that showed LMMAs were generally established through five phases (Table 2, Fig. 1): Conceptualisation, b) Inception, c) Implementation, d) Monitoring and management, and e) Ongoing adaptive management.

The five phases of LMMA establishment are described briefly below and can be defined into the period of 'establishing a LMMA' (Phase 1–3) and the period of 'managing a LMMA' once it is in operation (Phase 4–5).

2.1. Phase 1: Conceptualisation

This phase involves exploring the main idea, root cause and origin of the proposition for establishing a LMMA. The phase articulates awareness of LMMA benefits and the process, whilst integrating local indigenous knowledge, scientific knowledge and potential issues. It further identifies ownership of the process (community, government, NGO), as well as who are the champions (motivator, lobbyist) of the idea. Before moving on to phase 2, there is endorsement by the community that a LMMA is desirable.

2.2. Phase 2: Inception

This phase explores whether the community and other key stakeholders understand the LMMA concept, process, terms, roles and responsibilities between key stakeholders, and its impacts and merits. It involves training, awareness, consultation, identification of sources of financing and begins the drafting of an education and awareness plan, a financial plan, a management plan and conducting a training needs assessment. A completed draft management plan often marks moving to the next Implementation phase.

2.3. Phase 3: Implementation

This phase involves finalising and adopting the management plan, developing a monitoring plan for ecological and socio-economic assessments, and an enforcement patrol plan for the LMMA regulations. It notes avenues for institutionalisation and marks formal legalisation of the LMMA, or at least steps taken towards this. Steps taken to realise the LMMA are generally through demarcation (placing of buoys), a signed agreement and a completed management plan. It also involves training of members in LMMA management. Challenges of land ownership that may affect implementation are identified. The highlight of this phase is the agreement and readiness by key stakeholders for management and monitoring.

2.4. Phase 4: Monitoring and management

This phase focuses on management effectiveness, efficiency and adoption of the monitoring plan to assess ecological and socio-economic impacts of the LMMA and effective enforcement patrols. It adopts lessons learnt in phases 1, 2 and 3. This phase involves endorsement and implementation of good management structures.

2.5. Phase 5: Ongoing adaptive management

This is a dynamic phase that focuses on the sustainability of the LMMA, continuous implementation of the strategies and plans mentioned above and review of the LMMA functioning for the purpose of improvement. It involves dissemination of information in varying formats for stakeholders. This fifth phase, if operating successfully, indicates successful long-term implementation of LMMA activities. It is informed by the earlier phases, is continuous and involves learning by doing.

3. Results

We found documentation on 24 LMMAs including information

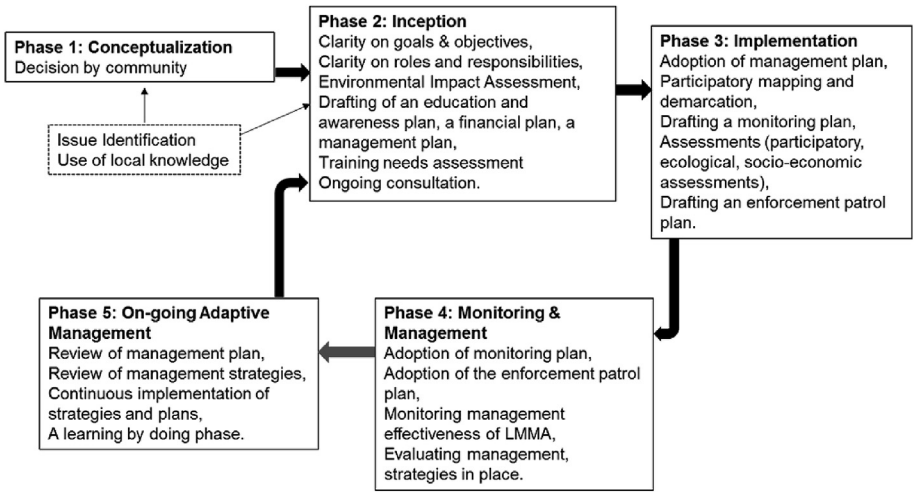

Fig. 1. Diagrammatic representation of the five phases of LMMA establishment.

on five declared in 2015 – three in Lamu County around Pate Island and two on the south coast near Msambweni (Fig. 2, Table 3). There was minimal documented information on four LMMAs (Majoreni, Mkwiro, Mwaembe and Tradewinds). The five recently established ones are listed but not reviewed further because they are so new. Most of the LMMAs were located in Kwale County on the south coast of Kenya (Fig. 2) and all were at different stages of development and establishment.

In the following section we detail the findings from 14 LMMAs within the structure of the five phases described above. Integrated into these findings are the results from 23 key informant interviews from 10 of these LMMAs.

3.1. Conceptualisation

The initial interest for establishing LMMAs was reported to come from five main sources: a) participatory research where communities were involved in field based ecological assessment; b) capacity building in marine conservation carried out by NGOs; c) availability of donor funding; d) local knowledge; and e) religion and culture linked to marine conservation, though the latter only reported from 1 LMMA (Table 4). The key stakeholders who were the local community, did not completely understand the LMMA process, though they had discussed the areas for their LMMAs. A general fear that the government would later turn LMMAs into a government marine park was voiced by some in interview. All key informant respondents identified champions in each LMMA who had lobbied the community to accept the LMMA concept (Table 4).

A variety of government institutions, NGOs, private investors and local stakeholders often in collaboration with each other, worked with communities to establish each LMMA (Table 3). In most LMMAs the State Department of Fisheries (SDF), NGOs and research institutions provided technical support. Most LMMAs were formed by one BMU. But in four cases fishers from more than one BMU or landing site came together to form the LMMA (Table 5).

The Conceptualisation phase involved prolonged deliberations which varied from 2 to 4 years (Table 4). Deliberations took place during community meetings which mostly consisted of BMU members. Few meetings addressed the larger community. Agreements were captured in minutes which were signed by the BMU executive committee. Once signed, it was assumed that there was total acceptance of the LMMA by BMU members and the larger community, which was often not the case.

3.2. Inception

By the Inception phase, in all LMMAs stakeholders did not completely understand the LMMA process. However, they were clear about their goals and objectives, and the roles and responsibility of stakeholders had been defined (Table 4). They had identified a potential LMMA site during discussions for and against establishment but they were still uncertain about the size and boundaries of the site since no demarcation had been carried out. Three LMMAs had carried out an Environmental Impact Assessment (EIA) and five had begun developing a draft management plan (Table 4). Kuruwitu had its initial management plan prepared by the KCWA committee which was improved four years later by EAWLS. Kibuyuni LMMA drafted its co-management plan in 2011 a year after it was established, while Wasini's was drafted in 2013, five years after establishment (Table 3). However, preparation of management plans was not participatory, most were prepared within a very short time which did not allow full involvement of the community. For all LMMAs several plans of operation had not yet been initiated in this Inception phase. For example, there were no plans for education and awareness, finance or a training and resource needs assessment (Table 4).

3.3. Implementation

For the five LMMAs that had started preparing their management plans in phase 2, four had completed them by phase 3 (Table 4). However, none of the 10 LMMAs had yet demarcated the area with buoys. No-Take Zones and gear restrictions were adopted as management approaches in all sites but again no agreement had yet been signed on these approaches except through minutes taken during meetings. All LMMAs applied BMU regulations and local imposition of fines to ensure compliance.

According to interviewees from 10 LMMAs, the institutional framework and the legal basis for LMMAs were fairly well understood. All were anchored under the Fisheries Act which enables BMUs to make and enforce their own by-laws and through this establish a LMMA. By this third Phase, five of the LMMAs had either initiated or completed this legal process (Table 5). Kuruwitu's LMMA, led by KCWA, initially explored the Environment Management and Coordination Act (EMCA 1999), through sections 54 and 55, which provide for the declaration of an area as a protected area. However, for this legislation to apply, it required that the

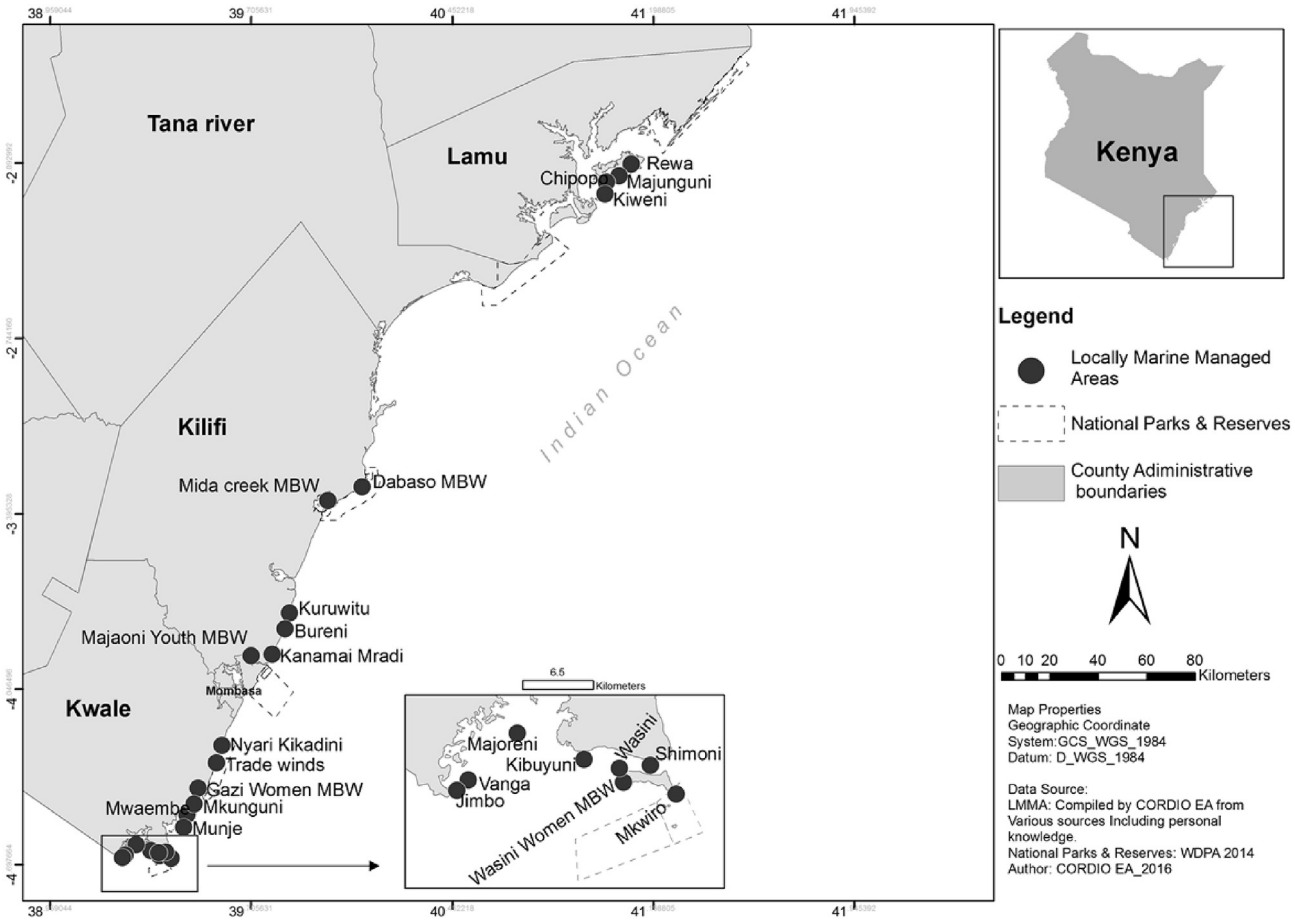

Fig. 2. Locations of 24 LMMAs along the coast of Kenya.

communities liaise with the Minister before the declaration was undertaken or that regulations were developed. This approach proved difficult and was never concluded but instead KCWA joined their local BMU to gain legal recognition of the LMMA by SDF through the BMU legislation.

BMU representatives from all 10 LMMAs interviewed had been trained in basic management skills by SDF, KWS and NGOs, though training was sometimes limited to BMU leaders only. One of the respondents linked this to creation of a vacuum when trained leaders left their positions.

All 10 LMMAs had developed a monitoring plan (Table 4) which involved ecological and socio-economic assessment. These were organised by external organisations with little involvement of BMU members. Socio-economic assessments were conducted as a one off activity in all LMMAs, but were not part of regular monitoring (see 3.4 below). Nine LMMAs had also started developing their enforcement patrol plan which was led by the BMUs.

This phase had challenges of lack of access to land, poor marketing and inadequate funding. Interviews revealed that land ownership or lack of access to land limited activities of all LMMAs. For example, Jimbo, Kanamai-Mradi, Kuruwitu and Wasini BMU owned no land and had minimal beach access. Wasini BMU overcame this problem by collaborating with neighbouring investors who in turn provided land to support activities. Kuruwitu was offered land by the local administration to construct an office. They also maximised use of beach access to construct resting sheds and sanitation facilities.

Funding was a major challenge mentioned by all respondents. LMMA activities were highly visible when donor funding was available but dropped off dramatically when funding ceased. For instance, during a relatively short time frame (2009–2012) five LMMAs were established between Shimoni and Vanga, two of these with complete management plans, and ecological and socio-economic surveys conducted during the EAWLS/FFI Darwin Initiative project. The same occurred in Kuruwitu from 2008 to 2010 with funding from the Community Development Trust Fund (CDTF). However, all interviewees responded that these LMMAs have struggled to maintain their activities due to little further funding. There were exceptions: Kanamai-Mradi received minimal external support compared to other LMMAs but went on with activities equally successfully. The same applied to Nyari-Kikadini which funded its activities from visitor entry fees, however, this then stalled following internal wrangles on leadership and revenue sharing. Kiweni raised revenue by charging access to snorkelers who visited the reef, however, lack of ongoing donor support, lack of monitoring and infighting between the key community groups has hampered its ongoing implementation.

3.4. Monitoring and management

By this phase six of the 10 interviewed LMMAs had adopted the monitoring plan that was developed in Phase 3 and ecological and socio-economic assessments were done (Table 4). Preliminary assessments were also conducted in a further three LMMAs: Majoreni, Tradewinds and Mkwiro. Improvements in coral cover and fish biomass were reported from five LMMAs (Table 4).

Nine out of 10 LMMAs interviewed had adopted an enforcement patrol plan and enforcement patrols were reported to take place

Table 3
A list of 24 Kenyan LMMAs including mangroves community conservation areas and 6 newly established LMMAs in 2015. MBW = Mangrove board walk, M = Mangrove; CR = Coral reef; N=Newly established; MR = Mangrove restoration; NTZ=No-Take Zone, GR = Gear restriction; - = information not available. No = management plan not yet produced. See text for partner and group acronyms. NB 1ha = 0.01 km^2.

LMMA	Year formed	Year of management plan	Size km^2	Management Type	Lead group	Other partners	Legislation
Mida Creek MBW	1995	–	–	MR	A-Rocha Kenya	KEFRI	Forest Act
Gazi Women MBW	1999	–	–	MR	Gazi Women	KMFRI, KEFRI	Forest Act
Wasini Women MBW	2000	–	–	MR	Wasini Women	KWS, KEFRI	Forest Act
Majaoni Youth MBW	2003	–	–	MR	Majaoni Youth	Kwetu Training Centre, KEFRI	Forest Act
Dabaso MBW	2006	–	–	MR	Mida creek Community Conservation	KEFRI	Forest Act
Kuruwitu CR	2006	2010	0.29	NTZ	Local residents & fishers, KCWA	EAWLS, WCS, SDF, KWS, IUCN, AFEW, Safaricom, WWF	Fisheries Act
Wasini CR	2008	2013	0.50	NTZ	EAWLS/FFI	WCS, ANO, SDF, KWS KMFRI	Fisheries Act
Nyari-Kikadini CR	2009		0.13	NTZ	WCS	SDF	Fisheries Act
Tradewinds CR	2009	No	0.12		WCS	WCS, SDF.	Fisheries Act
Jimbo	2009	No	–	GR	EAWLS/FFI	EAWLS SDF, KWS	Fisheries Act
Vanga CR	2010	2011	–	GR	EAWLS/FFI	SDF, EAWLS	Fisheries Act
Shimoni CR	2010	No	0.11	GR	EAWLS/FFI	WCS, SDF.KWS WCS, SDF.KWS	Fisheries Act
Majoreni CR	2010	No	–	GR	EAWLS/FFI	WCS, SDF. KWS, KMFRI	Fisheries Act
Kibuyuni CR	2010	2011	0.28	NTZ	EAWLS/FFI	WCS, SDF, KWS, KMFRI, Pact-Ke	Fisheries Act
Kiweni CR	2010	No	3	NTZ	LamCOT	SDF, Peponi hotel, Manda Bay Resort Lamu, BMUs, WWF, TNC, NRT-Coast, PMCC	Fisheries Act
Kanamai-Mradi CR	2011	2012	0.22	NTZ	WCS	SDF	Fisheries Act
Bureni CR	2013	No	0.52	NTZ	Bureni Turtle Watch	WCS, SDF, KWS	Fisheries Act
Mkwiro CR	2014	No	0.16	GR	EAWLS/FFI	WCS, SDF, KWS, KMFRI	Fisheries Act
Mwaembe CR	2014	No	0.46	NTZ	WCS	SDF, County government	Fisheries Act
Munje CR	2015	2015	0.7	N	COMRED	SDF, County government	Fisheries Act
Mkunguni CR	2015	2015	0.27	N	CORDIO EA	SDF, County government	Fisheries Act
Rewa CR&M	2015	No	9.69	N	TNC/NRT-Coast	PMCC, SDF, FFI	Fisheries Act
Majunguni CR&M	2015	No	10.7	N	TNC/NRT-Coast	PMCC, SDF, FFI	Fisheries Act
Chipopo CR&M	2015	No	17.3	N	TNC/NRT-Coast	PMCC, SDF, FFI	Fisheries Act

regularly in five LMMAs (Table 4). Where patrol activities were successful, they were carried out by BMU members, a specific committee and fishers who looked out for irregular activities while active in their routine fishing. Enforcement patrols were inconsistent in other LMMAs: Shimoni and Jimbo only reported a one-off patrol carried out in early 2013 by SDF officers and at Kiweni there were only regular patrolling activities when funds were available.

LMMAs that had reached this phase reported exposure to various skills for managing LMMAs, but only Kuruwitu had achieved all steps in this phase (Table 4). Knowledge of costs for LMMA implementation were still unknown though two LMMAs reported they could sustain most operations without external support (Table 4).

3.5. On-going adaptive management

None of the 10 LMMAs interviewed had fully engaged in this fifth phase because there was little evidence of implementation of strategies, plans and in particular a review of the LMMA functioning. Only two LMMAs had reviewed their management and financial plans, none had reviewed their training and capacity needs and only four reported using information from ecological monitoring to inform management (Table 4). Further, only Kuruwitu and Wasini had reviewed their marketing and awareness strategies. Kuruwitu had produced brochures, signboard, t-shirts, an educational video, website, articles and newsletters. Both these LMMAs reported having plans to work with relevant institutions to market their LMMA and tourism related products. Wasini planned to develop a website to showcase its marine resources and unique attractions. Although the other LMMAs did not have a marketing strategy, BMUs affiliated to Kiweni for example, obtained visitors by networking with tourist centres in Lamu and Vanga planned to market itself as an historical site to increase its visibility to a national and international audience.

Four LMMAs reported having engaged in documentation of lessons learned and exchange of information during the WCS/SDF Annual Fishers Forum and those held by the Indian Ocean Water Body Network (IOWB). These meetings allow presentation and discussion of research findings, coral reef status of different LMMAs and any emerging issues affecting BMUs.

No respondent could estimate the cost of establishing their LMMA. This was because the costs were borne by a donor, a research institution or other organisations that worked in the LMMA site and information on costs incurred was not shared with the LMMA implementing body, the BMUs. This left community members unable to understand the magnitude of investments needed for developing LMMAs. However, records of Kuruwitu LMMA showed that they had spent an overall cost of 25 million Kenya Shillings (approximately USD 250,000) establishing and operating their LMMA over 9 yrs, of which 18 million (USD 180,000) was used during phase 4 and 5. These costs are inclusive of construction and land development projects.

4. Discussion and recommendations

This study demonstrates there has been a rapid increase in the number of coral reef based LMMAs forming on the Kenyan coast over the last 10 years, from one in 2006 to 19 by 2016. A similar pattern was seen in the Philippines in the 1990s where it took 10 years to establish the first LMMA at Apo Island (Russ and Alcala, 1999), but subsequent LMMAs came into effect rapidly over the

Table 4
Summary of results from key informant interviews (n = 23) in 10 LMMAs on the processes of establishing LMMAs and their effectiveness. Results are structured by the five LMMA development phases (see Table 2). PR - Participatory research, Ea - Education & awareness, F - Funding, LK - Local knowledge, RC - Religion & culture. NTZ - No-Take zone; GR - Gear restriction; Yes - the activity was carried out during the phase; No - activity was not carried during the phase; - = information not available.

	Kuruwitu	Kanamai-Mradi	Shimoni	Bureni	Nyari-Kikadini	Kibuyuni	Kiweni	Vanga	Jimbo	Wasini
1. Conceptualisation										
Reasons for initial interest for LMMA	PR, Ea, F	PR, Ea, F, LK	PR, Ea, F	PR, Ea, F	PR, Ea, F	PR, Ea, F, LK	PR, Ea, F	PR, Ea, F, RC	PR, Ea, F	PR, Ea, F
Identification of general area for LMMA.	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Identification of stakeholders	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Identification of champions	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Time frame (years)	4	3	–	–	2	2	2	2	–	2
Endorsement of LMMA idea with signed agreement.	Signed minutes	Signed minutes	Signed minutes	Signed minutes	Signed minutes	Signed minutes	Signed minutes	Signed minutes	Signed minutes	Signed minutes
2. Inception										
Understanding of LMMA process	No	No	No	No	No	No	No	No	No	No
Defining goals and objectives of LMMA	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Defining roles and responsibilities of stakeholders	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Agreement by stakeholders on specific LMMA site	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Knowledge of exact location of the LMMA, size and boundaries by stakeholders	No	No	No	No	No	No	No	No	No	No
Environmental Impact Assessment	Yes	No	No	No	No	Yes	No	No	No	Yes
Commencement of preparation of a management plan	Yes	Yes	No	No	No	Yes	No	Yes	No	Yes
Was the process participatory	Partly	Partly	Partly	Partly	Partly	Partly	Partly	Partly	Partly	Partly
Preparation of an education & awareness plan	No	No	No	No	No	No	No	No	No	No
Preparation of a financial plan	No	No	No	No	No	No	No	No	No	No
Conducting a training needs assessment	No	No	No	No	No	No	No	No	No	No
3. Implementation										
Completion and adoption of the draft management plan	Yes	Yes	No	No	No	Yes	No	Yes	No	No
Establishment of LMMA with buoys	No	No	No	No	No	No	No	No	No	No
Development of a monitoring plan	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Development of an enforcement patrol plan	Yes	Yes	No	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Management interventions adopted	NTZ	NTZ	GR	NTZ	NTZ	NTZ	NTZ	GR	GR	GR
Existence of signed agreement/minutes on establishment of the LMMA	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Understanding of legal and institutional requirements of the LMMA	Partly	Partly	Partly	Partly	Partly	Partly	Partly	Partly	Partly	Partly
Was the legal basis of the LMMA formalized or at least initiated?	Yes	Yes	No	No	No	Yes	No	Yes	No	Yes
Members trained on basic management	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Challenges of land ownership	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Cost	–	–	–	–	–	–	–	–	–	–
4. Monitoring & Management										
Monitoring plan adopted by community	Yes	Yes	No	Yes	Yes	Yes	No	No	No	Yes
Ecological assessments	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Improved ecological resources/ fisheries/habitats	Yes	Yes	No	No	Yes	Yes	No	No	No	Yes
Adoption of an enforcement patrol plan	Yes	Yes	No	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Effective enforcement patrols	Yes	Yes	No	Yes	No	Yes	No	No	No	Yes
Community skills improved	Yes	Yes	No	No	No	Yes	Yes	No	No	Yes
Maintained boundaries	Yes	No	No	No	No	No	No	No	No	No
Proper use of equipment	Yes	No	No	No	No	No	No	No	No	No
Self-sustaining	Yes	Yes	No	No	No	No	No	No	No	No
Cost of the phase	–	–	–	–	–	–	–	–	–	–
5. Ongoing Adaptive Management										
Review of management plan	Yes	No	No	No	No	No	No	No	No	Yes
Use of information from monitoring	Yes	Yes	No	No	No	Yes	No	No	No	Yes
Review of training & capacity building	No	No	No	No	No	No	No	No	No	No
Review of marketing/awareness strategy	Yes	No	No	No	No	No	No	No	No	Yes
Review of financial plan	Yes	No	No	No	No	No	No	No	No	Yes
Documentation & sharing of lessons	Yes	Yes	No	No	No	Yes	No	No	No	Yes
Cost of the phase	–	–	–	–	–	–	–	–	–	–

next two years (White et al., 2002). Similarly, in Fiji the first LMMA was established in 1997 and by 2011 there were 245 covering an area of over 10,000 km^2 involving 380 villages (Sivo, 2011).

In both the Philippines and Pacific Island States the rapid uptake of LMMAs was attributed to the presence of an exchange visit: where coastal community members are taken to an existing LMMA to see it *in situ* and talk to the hosting community of fishers. Our results confirm this since all interviewees attributed exchange visits as a key factor in initiating the development of their own LMMA, a view that is also consistent with other coastal

Table 5
BMUs and/or landing sites that came together in agreement to form an LMMA.

LMMA	Landing sites and/or BMUs
Kuruwitu	Mwanamia, Kijangwani, Kuruwitu, Kinuni, Vipingo, Bureni
Nyari-Kikadini	Nyari, Kikadini BMUs
Kanamai-Mradi	Jumba, Kazungu wa Shungu, Mwendo wa Panya landing sites
Kiweni	Pate, Shanga Rubu, Shanga Ishakani, Shela and Lamu BMUs.

conservation studies in East Africa (Wells et al., 2007). The exchange visit for Kuruwitu fishers to Tanga to see the first LMMAs in East Africa (Wells et al., 2007, 2010). Spurred the establishment of Kuruwitu. Kuruwitu has in turn helped trigger the establishment of other LMMAs in Kenya through exchange visits (Murunga and Kawaka, 2015). In the Pacific, exchange visits benefited local communities in terms of sharing marine conservation approaches, exposure to community development initiatives and networking (Stacey et al, 2015).

This study found other common factors that are driving the establishment of LMMAs in Kenya: informed and committed community members, past training in community based marine resource management, a supportive legal framework, external funding and opportunities for sharing LMMA information. In the 10 LMMAs we interviewed there were community leaders who championed establishing an LMMA. These leaders acted as the link between the community, the government and the NGOs because they had the backing and trust of most of the local community. Such champions are found to be critical in successful local fisheries management initiatives (Gutiérrez et al., 2011). Further, efforts by government and NGOs to build the capacity of fishing communities in marine resource management have resulted in more enlightened and empowered fishing communities (Samoilys and Tuda 2009, Ministry of Livestock and Fisheries Development 2013). These training activities were closely linked to the fisheries co-management legal framework, the BMU, enacted in 2007 (GoK, 2007), which gave communities a legal anchor for the formal recognition and establishment of LMMAs (Odote et al., 2015). Kenya's revised Constitution (2010) also emphasises the involvement of the larger community in managing natural resources. This is possible through networks, as has been applied in Madagascar (Mayol, 2013). A national network of LMMAs creates opportunities for communities to learn from the successes and shortcomings of each other. Such networks were also recommended by Rocliffe et al. (2014).

The existence of donor funding and external organisations were critical to all 19 LMMAs and these external actors also provided technical support and training through the different phases of the LMMAs. External support also played an important role in Pacific Island states where >100 NGOs supported LMMAs (Govan et al., 2009). The growth of LMMAs in Philippines is partly attributed to donor agencies and development NGOs and is facilitated within the context of city governance legislation and support (White et al., 2002). In the WIO, LMMAs have also been established in Madagascar and Tanzania, facilitated by external actors providing funding and training, together with an enabling co-management legislation (Cinner et al., 2012; Rocliffe et al., 2014).

The converse of the key factors that have helped drive the establishment of LMMAs in Kenya reflect their challenges. Inadequate education and awareness, inadequate funding, and inadequate attention paid to enforcement and other operations are weaknesses that plague LMMAs throughout the WIO (Rocliffe et al., 2014; Maina et al., 2011; Samoilys et al., 2011; Wells et al., 2010). Although training has occurred in many of the LMMAs, we found that in the 10 LMMAs interviewed, education and awareness activities did not reach the majority of the community. This was particularly noted during the initial three phases in which the foundations of the LMMA are established. It is therefore recommended that an education and awareness plan is considered early in the process, to help secure all stakeholders' acceptance and ownership of the new LMMA.

Interviews revealed that 10 LMMAs lacked full understanding of the cost of establishing (the three initial phases – conceptualisation, inception and implementation) and managing (the last two phases – management and monitoring and ongoing adaptive management) LMMAs. Except for Kanamai-Mradi, all nine LMMAs relied heavily on donors, NGOs and the government for financial and technical resources. Consequently, when the donor funded project ended the LMMA struggled due to lack of finances. This was the reason that five LMMAs never managed to draft their management plans because they no longer had the funds to do so. Most significantly, all LMMA managers informed us that they did not have access to the budgets used by donors and NGOs on establishing their LMMA and were therefore unaware of the costs. Non-monetary resources, such as time, labour, land, donated materials and technical expertise by national institutions, NGOs and local investors are also important contributions to LMMA activities. All these resources support the establishment of the LMMA by the larger fishing community and government but are often not recognised. Putting a value to these inputs was beyond the scope of our study and remains an important area of research.

Recognising the problems of lack of sustainable financing of LMMAs, The Nature Conservancy and partners plan to introduce a business approach to the marine conservation areas they are supporting north of Lamu (Maina pers. obs.). It is critical that communities have knowledge of the cost of establishing an LMMA to help them plan, taking into consideration available finances and efforts required to obtain additional funds. Currently an estimated cost (time and money) per LMMA phase is unknown: one LMMA reported an average cost of ~USD27,000 per year over nine years. Clearly, further work is needed to unravel this. A marketing strategy and a benefit sharing mechanism are also recommended to enable LMMAs to function independently of external donors. Sustainable funding issues around protected areas are not new - a global review of the costs of implementing Protected Areas found that only 16% have adequate funding (Balmford et al., 2004; McCrea-Strub et al., 2011).

Despite the clear recognition in most of Kenya's LMMAs that enforcement is important, evidenced in the existence of an enforcement plan, only four LMMAs were regularly patrolling their LMMA. Lack of active enforcement on the water is ongoing in both government and community run protected areas in many coral reef MPAs, rendering them equivalent to “paper parks” (Alder, 1996; Samoilys et al., 2007, in press; Guidetti et al., 2008; Samoilys et al, in press) though the reasons communities do not always enforce regulations are complex (Stevens et al., 2015). It is recommended that enforcement is given greater prominence early in the LMMA establishment process and could build on success stories in East Africa such as the TCZCD which had consistent management plans for their six LMMAs from 1999 to at least 2007 and included enforcement patrols which were done jointly between government (Fisheries Department) and community representatives (Wells et al., 2007).

We found Kenyan LMMAs go through five phases of establishment rather than the four phases reported from the Pacific Islands (Govan et al., 2009). The additional phase being the first “Conceptualisation” phase. We found that this phase was critical so that the community endorsed the idea that an LMMA is desirable. If this phase was skipped or too brief, the next steps of establishment

either stalled or moved very slowly. The success of many Pacific LMMAs has been attributed to long term engagement with communities which may indeed capture the 'Conceptualisation Phase' as part of the Inception phase, but it has not been specifically recognised in the literature (Johannes, 2002; Govan et al., 2009. To emphasise the importance of the Conceptualisation phase, we suggest that it be given greater prominence in eastern Africa by emphasising the potential LMMAs have in enhancing food security through improved resource abundance and empowering local communities through fisheries co-management (Mascia et al., 2010; Stevens et al., 2015). LMMAs have the potential to have a positive impact on the social well-being and political power of fishing communities but this is not always realised.

In summary, our study shows that the reason LMMAs have become established so rapidly in Kenya is due to the presence of six key factors which we therefore recommend as essential: leaders in the community who will champion the LMMA; education, awareness and training in community based marine resource management; a supportive legal framework and government; and, initially, an external source of funding. The sixth factor, an exchange visit to an existing LMMA, appears to be a significant trigger in stimulating a community to first consider establishing their own LMMA. We also show that there are 5 distinct phases of establishment in Kenya's LMMAs, and the early Conceptualisation phase appears to be critical in getting the whole community involved and committed. However, for the LMMA to be sustainable in the long term community managers need to be closely involved in the budgeting and costs of establishing and running their LMMA. There are a variety of funding mechanisms that can be considered, including Payment for Ecosystem Services and Condition Cash Transfers (e.g. Spergel and Moye, 2004; Samoilys, 2011), that need to be discussed early in the process. The initial external funding could also contribute to a trust or other revenue collecting mechanism that broadens the financial benefits of an LMMA and thereby ensures its sustainability in the long term. We recommend future efforts in establishing LMMAs in eastern Africa give priority to long term sustainable funding mechanisms. Finally, we recommend that the five phases of establishment and the six factors for success could contribute to national guidelines on LMMAs in Kenya as well as be applied more broadly to LMMAs in the western Indian Ocean (WIO) region.

Acknowledgements

We would like to thank the UNDP-GEF Small Grants Programme (KEN/SGP/OP5/FSP/BD/13/08 - CORDIO East Africa) for funding and Ann Ray Charitable Trust (ARCT) for supporting George Maina. Our gratitude goes to leaders of Beach Management Units (Kibuyuni, Shimoni, Nyari-Kikadini, Vanga, Jimbo, Bureni, Kuruwitu, Mradi, Mkwiro, Wasini and Pate) Dr Nina Wambiji of KMFRI and Des Bowden of KCWA for their perspectives on LMMAs, and James Mbugua of CORDIO East Africa for the map. It is our hope that this paper will be of value for all LMMA practitioners.

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