

The Potential for Locally Managed Marine Area (LMMAs) as a Participatory Strategy for Coastal and Marine Ecosystems- the Global Commons

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Abstract: Marine and coastal biodiversity and ecosystem services are degraded in many areas worldwide due to human interference resulting from fishing, tourism, pollution, and mining. Guidelines for an evidence-based, participatory and community-led management approach ‘Locally Managed Marine Area (LMMA)’ provides a planning and strategic approach to development of coastal cities and implementing Integrated Coastal Zone Management. Here we take note of the existing references of case studies that shows successful implementation in Fiji, Kenya and other countries in Asia and Africa. LMMA approach integrates concerns about the current state of degradation and ensures that ecological services of these resource systems are sustainably managed in the future by community driven efforts; with aspects of food security, resource conservation, local employment and income of local fishers and tourism operators embedded. We focus on an empirical assessment initiated through a collaborative effort to outline and set up guidelines for establishing a LMMA network for Inhambane, Mozambique in discussion with stakeholders (fishermen, tourism operators, private and community actors, and selected government officials). An outcome from the study was disseminated to local authorities to ensure that solutions for managing degradation coastal and marine ecosystems could be placed on priority as planning for implementation of Sustainable Development Goal 14 and for creating coastal cities as sustainable economic hubs and resilient coastal communities.

Keywords: Community-based; Locally Managed Marine Areas; Marine Resources; Sustainable Development

Introduction

Given the increased stress climate change and anthropogenic activities are putting on fragile marine ecosystems, the way in which marine and coastal resources are managed is essential to the survival of local communities. It is important to consider that there is a diverse values that people place on nature and that conflicts over these values are important considerations when managing common-pool resources. For example, local, Indigenous values may vary or be in direct conflict with tourism operators or larger harvesting companies all competing for limited resources. Locally Managed Marine Areas (LMMAs) offer an emerging participatory management approach that can be used to balance the different interests often involved in decision-making regarding conserving nature and sustaining local coastal communities.

Locally Managed Marine Area’ is a term that encompasses a range of management styles being used to foster collaboration in nearshore waters and coastal resource use can best be balanced considering different stakeholders’ needs [1]. These stakeholders include local community members, government, and others involved in balancing the demands of people and nature requirements for coastal and marine resource use within the given area [1]. Since

being conceptualized in 2000, the use of LMMAs has increased globally, especially in the South Pacific [1]. This management style allows the unique circumstances of each area to be taken into consideration and grounded locally in a bottom up rather than a top down approach [1].

Global commons are areas, such as high oceans, where no single nation has jurisdiction and common-pool resources are found [2]. While not designated as sovereign territory with national legislation regulating resource use, rules do exist within global commons about the sharing of resources amongst multiple stakeholders [2, 3]. However, there are important examples of where common-pool resources, such as the global whale population, are overexploited or the needs of many different people and nature are ignored [2, 3]. While the overexploitation of whales globally led to the decision in 1982 to create a moratorium on whale hunting through the banning of commercial whaling in 1986, as distinct from Aboriginal subsistence whaling, enacting this legislation in Canada was more complex. In the Canadian Arctic the use of beluga and other whales for human consumption and cultural practices of the Inuit was contrasted with the live capture of whales for aquaria, demonstrating this complexity in implementing the global ban and the importance of local stakeholder involvement in decision-making to protect Inuit harvesting rights [2, 3]. Balancing local Indigenous subsistence needs and views on conservation, scientific understandings of conservation, and corporations' resource requirements allows coastal marine resources to be shared in an equitable way.

Many different tools and management approaches exist for coastal or offshore marine resources, which can be categorized based on their management target or what level of governance and community engagement is involved in the process [4]. Management styles which use ecosystem approaches – decision-making informed by the relationship between humans and nature – include integrated coastal zone management (ICZM), integrated coastal management (ICM), coastal resource management (CRM), and ecosystem approach to fisheries management (EAFM)[4, 5]. Furthermore, marine protected areas (MPAs) and marine spatial planning (MSP) are considered tools that can be used by these different approaches [4, 5]. Such traditional marine management mostly applies a top-down approach that prioritizes national or nature conservation goals over the needs of local people, through Marine Protected Areas and other national legislation within global commons, except where specific provision for co-management exists.

Conventionally, the primary management approach employed by Marine Protected Areas (MPAs) is to identify “*a clearly defined geographical space, recognised, dedicated and managed, through legal or other effective means, to achieve the long-term conservation of nature with associated ecosystem services and cultural values*”[6p. 12]. The aim of MPAs was to support climate change adaptation, tourism, governance, health, enhance ecosystem resilience, protect ecosystem services, balance conservation and development goals, and the empowerment of women [7–9]. However, in many instances MPAs failed to take into consideration the complex socio-ecological systems, lack of funding, contributions to local power asymmetries, conflict due to a lack of understanding of local social dynamics and international cooperation, and protection of natural wealth and resources beyond the limits of national jurisdiction [2, 7, 8]. Defacto expropriation of coastal resources by globalized economic forces also poses serious challenges to local communities [10]. The recent literature reflects that for MPAs to be successful they need to incorporate traditional, local, and Indigenous knowledge about balancing conservation and human needs within decision making processes through local institutions, a task that in some quarters is increasingly being taken on by the community through LMMAs [7, 8, 11].

MPAs represent one example of previous management styles for resource use and access rules in a defined space that use top-down, centralized approaches at a national level with limited input from local people[1, 8, 11–13]. The framework did not appropriately consider the needs and concerns of local subsistence resource users (Bolton et al., 2010; Cohen, Jupiter, Weeks, Tawake, & Govan, 2014; Govan et al., 2009; Mahajan & Daw, 2016), thus creating a need for approaches which include multiple stakeholder input into decision-making. Community-based models became promoted by NGOs and national governments to address these failures through the promotion of decentralized governance in marine management [8, 12]. These efforts involved significant input from northern Canada in the 1980s and spread globally to recognize “the power and rights of local fishing communities to manage their marine resources” [13p. 4] and promote community-ownership to allow local stakeholders more responsibility over resource management. Indigenous peoples were an important part of these efforts through their local and Indigenous knowledge (ILK) about conservation approaches and awareness of local stock numbers for example.

In contrast to these top-down management approaches, LMMAs represent an approach to managing resources that begins with the inclusion of communities in decision-making as a way to address the gaps in previous approaches. An important benefit of LMMAs is the integration of scientific knowledge with traditional ILK, which is important for understanding natural variability of each area (Govan, 2009; Jupiter et al., 2014; Mahajan & Daw, 2016).

Community-based management approaches are seen as sustainable ways to respect Indigenous and local uses of marine areas through the effects of engaging with local actors, peer-to-peer and social learning [18]. LMMAs also offer a means of legal formalization to respect the traditional knowledge, practices, and values of local communities which already have established concepts of conservation and sustainable use as part of their traditional culture of resource use (Govan, 2009; Syakur, Wibowo, Firmansyah, Azam, & Linkie, 2012). Communities view LMMAs as enabling “recovery of natural resources, improved food security, improved governance, access to information and services, health benefits, improved security of tenure, cultural recovery, and community organisation, ... [the] exclusion of other stakeholders from fishing areas, working with outside agencies, [and] their increased control over local resources” (Govan, 2009, pp. 7–8).

LMMAs are not a new method for management of resources, rather, for some regions, it is a new approach to include local communities along with other important local stakeholders when making decisions about which existing management tools will be used (Govan et al., 2009). This is demonstrated in the multiple iterations based on national legislation and history of resource management in the area under study, demonstrated in the case studies below. For example, some LMMAs are considered community-based Marine Protected Areas (MPAs) where the community, rather than the national government, regulates the area. Alternatively, in Fiji, LMMAs began as an area where a temporary harvesting ban was imposed to allow recovery of marine stocks, which then transitioned to using other current management tools once the ban was lifted [20]. LMMAs allow for a more inclusive and participatory approach to management of marine resources, which embeds existing management tools that have been successful into the process. It is tailored to the unique needs of nature in the area and people involved in harvesting these resources, and aligns with local, Indigenous harvesting practices and conservation knowledge.

It is important to consider what gaps may exist in implementing LMMAs which other jurisdictions can learn from, such as Arctic Canada. For example, LMMAs represent a different way of making decisions about resource use and in many cases require legislation to allow for these different stakeholders to be able to have a seat at the table. Additionally, in order for LMMAs to be successfully implemented there is important funding, education, and other supports that need to be met, as these case studies demonstrate.

Methodological Approach

Research questions

This article aims to understand the following research questions:

- What can be learned from the use of LMMAs in different cases that can be applied elsewhere?
- What gaps exist in the implementation of LMMAs that need to be addressed going forward?
- Is the use of LMMAs appropriate in the Canadian Arctic given the history of marine resource management?

This paper examines specific and representative case studies to understand factors that make the implementation of LMMAs more successful and gaps that need to be addressed in the future. A desk review and synthesis of existing knowledge was conducted to target relatively unrepresented regions in Africa and the Asia-Pacific as cases for understanding the strengths and weakness of the implementation of LMMAs in different contexts. In the case of Mozambique where existing published literature was limited, primary data collected by UNU-INWEH (United Nations University – Institute of Water, Environment and Health) on LMMA implementation use to inform this case. The desk review method applied in projects implemented by UNU and other development organizations was used to include multiple data sources and focus on specific countries for a targeted examination of key lessons regarding a specific policy or intervention of interest [21, 22].

Asian-Pacific and Small Island Developing States have led the implementation of LMMAs. The United Nations documentation regarding approaches to attaining the Sustainable Development Goals states that other countries can learn from these cases, creating a unique opportunity to include primary data about Mozambique along side other African (Kenya and Madagascar) and Asian-Pacific (Fiji and Myanmar) cases where more grey and published literature exists [23, 24].

When conducting the literature search, Scholars Portal and Web of Science were searched using the term “locally managed marine areas” and the country name for all countries included as cases. Google Scholar was also searched and results relevant to the cases were added to the literature search results. Scholars Portal generated 52 results, Web of Science generated 12 results, and Google Scholar resulted in more than 10,000 results. Duplicates were then removed and abstracts were reviewed to determine if the articles described one or more of the country cases or the history of LMMAs, leaving 77 relevant articles. All articles were reviewed for content describing LMMAs and their

history to inform the context, while articles in part or entirely about specific country cases were included in the comparative case study section.

Mozambique case

In addition to the desk review, Mozambique was included as an additional case informed by primary research, including focus group discussion, stakeholder consultations, and selected interviews. This case study was conducted in collaboration with UNU-INWEH and IUCN Africa, using qualitative research methods to analyze primary and secondary stakeholder data in order to answer a set of research questions and sub questions. This provides an interesting opportunity to compare current research regarding the implementation of LMMAs in Mozambique to existing LMMAs in the South Pacific and Africa. The results from this study conducted by UNU-INWEH were the most up-to-date data regarding the Mozambique case.

Results: Comparative Analysis using a Case Study Approach

Overview from the Asia-Pacific Region

Fiji: A mature leader in the LMMA implementation

Unique terrestrial and marine diversity has led to Fiji's coral reefs being an important resource for local food and income, tourist activities, and the protection of coastal areas from storms and floods [20, 25]. Coastal areas in Fiji are dominated by Indigenous peoples who use a community approach to management, property ownership, and their regulation style called 'qoliqoli' (Govan et al., 2009; Hastings et al., 2015). This existing system of resource management within Fiji's Indigenous communities has made it easier to adopt the community-based management system of LMMAs [25]. The qoliqoli management style in Fiji regulates where people can fish for legal and cultural reasons, restricts fishing methods, gear types, creates time limited fishing bans and tabu areas to balance the needs of the natural environment and local people harvesting these resources [25–27]. In 2000 the Fiji Locally Managed Marine Area Network (FLMMA) was created to scale up the success of LMMAs to a national level and allow for information sharing across the various sectors [25, 26, 28].

Fiji has experienced success in species recovery through LMMAs. For example, the first LMMA created in the early 1990s to address the issue of decreased clam stocks has resulted in recovery of Ucunivanua clam stocks in the Viti Levu island and incomes for the village have increased as a result [20]. LMMAs have also improved household welfare through stronger collective ownership rights, that enhanced food security as of increased consumption of fresh seafood harvested locally [29]. In Fiji, LMMAs, seen as community-based marine protected areas (MPAs), is the approach that the national government is using to achieve the goal set out by the International Union for the Conservation of Nature to have 30% MPAs by 2030 [27, 30]. However, researchers are suggesting that a combination of LMMAs and systematic, top-down approaches will be needed to achieve development goals and targets to ensure that legislation and funding is provided to local LMMAs and that the needs of different geographical regions can be balanced at a national level to meet the targets [30]. The FLMMA will likely play a large part in linking these two levels of governance as it is currently an integral part of Fiji's LMMA implementation success through the creation of partnerships across different qoliqoli, and among community members, scientists, and government agencies [28].

Myanmar: Acceptance to innovative thinking for coastal resources management

Myanmar's coastline spreads nearly 3,000 km inhabited by a large diversity of coastal and marine resources, which contribute to the country's fourth largest source of foreign exchange after timber, minerals and rice [31]. Nearly 24 mangrove species are found in the country, with the most extensive mangroves spread in the Ayeyarwaddy Delta. The evidence of poorly managed coastal zone use can be seen in the rapid decline and degradation of coastal vegetation of the Ayeyarwaddy Delta mangrove ecosystem from 250,000 hectares in the 1980's, to 110,000 ha in 2001, to 83,400 ha in 2012, and the decline is continuing [31, 32]. Additionally, the country is also frequently exposed to extreme climate events and lost nearly 60,000 ha of mangrove forest in the aftermath of Cyclone Nargis. The densely populated delta area is left in a crisis situation by the huge losses of life and livelihoods as a result of climate change and poor management. The gradient of unsustainable development is jeopardizing the fragile relationship between these crucial habitats and the livelihoods of rural people, thereby compromising most of the country's population and natural resources. Low income in the area is a challenge, so coastal landscapes are falling prey to aquaculture and human settlements [33]. Coastal resilience through community consultation and engagement has become an important focus of global sustainable development because environmental problems need to be addressed by more than just a resource management strategy, but also enhanced understanding of human-nature interaction, strengthening international agreements and dedicated flow of funding.

International collaboration and transfer of best management practices may offer a sustainable solution for this growing economy as they may skip the cost-intensive phase of research and development while learning from others. Fauna & Flora International has collaborated with the Myanmar Government to create their first three LMMAs, which was announced on World Ocean Day, June 8, 2017 (Davis, 2017). The process began with a scientific survey conducted from 2012 to 2014 with the collaboration of the Ministry of Environment Conservation and Forestry, the Department of Fisheries, and the Navy to identify species of coral, fish, echinoderms, crustaceans, molluscs, and sponges to understand the impacts of overfishing and destructive fishing techniques. This study of nature was used to inform future resource management techniques and to advocate for the creation of the LMMAs in the Myeik Archipelago. The aim of creating these 3 LMMAs in 2017, or thereafter, was to improve the health and biodiversity of reefs in the region through involvement of local people in operation and care [34–36].

The African Perspective on LMMA

Kenya: Leading way for the African region in LMMA implementation

Kenya's coastal and marine environment supports the livelihood of local communities through its rich but threatened biodiversity and numerous species [37]. Their economy relies on this biodiversity to attract tourists, support the fishing industry, while also being impacted by pressures from other sectors such as agriculture, forestry, mining, and shipping, causing degradation from over-exploitation of unregulated resource use, which threaten community livelihoods [37]. MPAs were created in Kenya in the 1970s as a conservation tool in keeping with international conventions, however, their implementation was problematic due to lack of local involvement [8, 37], making LMMAs a fitting and important management approach to balancing the needs of all of these important stakeholders along side concerns about nature conservation.

New legislation supported the change from the top-down resource management to community management through the Forest Act in 2005 and the Beach Management Units (BMUs) Regulation in 2007 [7, 13, 37]. In this legislation, BMU responsibility includes "law enforcement, developing sanitation facilities and onshore infrastructure for the landing, buying, and selling of fish, collecting fisheries data, conflict resolution and welfare matters, and handling emergencies" [8p. 110]. In 2006, the first LMMA was created in Kuruwitu, central Kenya, and more have been created since, either called community-managed MPAs, Community Conservation Areas (CCAs), or LMMAs [7, 13, 37, 38]. Kenya's LMMAs have been successful as demonstrated by the increase in live hard coral cover and fish numbers in the Kuruwitu LMMA [7, 13]. The rapid increase in LMMAs demonstrate that local communities see benefits of this management style despite limitations, such as lack of education and awareness, marketing, financing, and monitoring strategies [7, 13]. LMMAs in Kenya are supported by the East African Wildlife Society (EAWLS), Flora and Fauna International (FFI), Wildlife Conservation Society (WCS), as well as local organizations such as the Kuruwitu Conservation and Welfare Association (KCWA) [13, 38] and Coastal Oceans Research and Development - Indian Ocean (CORDIO).

Local community members have voluntarily established LMMAs to give their communities an opportunity for structured engagement in the conservation of natural resources while deriving human benefits from the same resources. The implementation process required collaboration between government - both the national and country level - and coastal communities. In order to establish LMMAs, tourism and artisanal fishery agents were analyzed to set up guidelines for the fishery and tourism sectors that can ensure sustainable use of ecosystems. The LMMA with a 'no fish-take' zone was established in 2006, necessitating the exploration of alternative livelihood activities through the use of corals and other marine life while the area was closed to fishing to recover from the effects of destructive practices and overfishing [13]. As a result, fish stocks and coral reefs recovered and fish catch in surrounding areas increased. Also, the biodiversity as a result of ecosystem conservation has resulted in increased snorkelling revenue that benefits the local economy [37]. In this way the LMMA was able to balance the needs for livelihood of local people and natural conservation mandate. At the same time, challenges remain concerning the manner in which LMMAs were established, as there is a lack of clear legal framework and guidelines for the establishment of community protected coastal areas [37].

Madagascar to inspire LMMA for Small Island Developing States (SIDS)

In Madagascar, an arid region, fisheries are an important resource, especially the reef octopus fishery which represents one of the top three economic activities in the area [39]. The seas also have important cultural heritage for traditional fishing communities and are a source of food security and job creation [12, 40]. In the early 2000s, traditional and subsistence octopus fishing areas became overexploited and unsustainably accessed by commercial fishers [39]. Community-based management through LMMAs are seen as a way to overcome the nation's political

volatility, economical instability, decreasing social well-being, and capacity to manage in a top-down manner [40]. This community-based management approach fits within traditional values about social code called 'dina,' which are community laws predating independence [7].

LMMA's have increased in order to meet the goal of tripling Madagascar's marine protected areas in five years set out in the Durban Vision [7, 40, 41]. LMMA's adoption in the country witnessed success in increasing catch as demonstrated in the first case in Andavadoaka, which focused on increasing their octopus stocks through a temporary closure supported by Wildlife Conservation Society and Blue Ventures [7, 39, 40]. In the seven years since its original success, LMMA's with temporary octopus closures have increased catches, enhanced catch compared to effort, and demonstrate that these benefits outweigh the costs of such management methods [12, 40]. LMMA's in Madagascar have been supported since 2006 by the Velondriake Association, which governs across multiple villages, as well as peer-to-peer learning and through the development of Andavadoaka as a training base, and Madagascar's first LMMA network called MIHARI [40].

Mozambique: Towards a vision for Coastal Cities as Sustainable Economic Hubs

Mozambique is a nation recovering from years of civil war and struggle for liberation and is beginning to decentralize decision-making, such as through LMMA's for marine resources (Govan, Tawake, & Tabunakawai, 2006). Co-management of marine resources began in Mozambique with the Fishing Community Councils (CCPs) and Co-management Committees (CCGs) introduced through the 2003 Regulation on Marine Fisheries and legislation in 2007 [7]. The CCGs involve multiple stakeholders at more of a top level while the CCPs are community-based organizations that function as LMMA's [7]. While the number of LMMA's has increased dramatically, few are recognized by the Mozambique Ministry of Fisheries, which has created many struggles associated with this local/national discrepancy (Govan et al., 2006; Rocliffe et al., 2014). As a result the Vamizi Marine Sanctuary is the only functioning LMMA in Mozambique due to its support from an eco-lodge on Vamizi Island and World Wildlife Fund [7].

An empirical case study for the Province of Inhambane, Mozambique that was a collaborative effort of UNU INWEH with regional agencies viz., IUCN outlined a feasibility analysis towards an 'intervention strategy' that provides stakeholder-driven vision for integrated and sustainable development by employing the LMMA framework. With an objective to outline strategies for sustainable development of coastal cities and enhance their resilience, the LMMA framework embeds tourism and fishery activities as drivers/influencers for coastal and marine habitats, integrating the needs of both nature and people in a given context. LMMA guidelines were charted by integrating in three categories; socioeconomic, ecological, and policy attributes of the socio-ecological system for the province of Inhambane as a pilot province, with a scalable potential for four municipalities, namely Inhambane (city), Maxixe, Massinga and Vilankulo. These LMMA guidelines support integrated development that will in turn support sustainable economic growth and social improvement as well as nature conservation and coastal resilience, while also identifying options for an intervention strategy that is mutually engaging.

Drawing from existing best practices, this empirical case study further identified modalities for minimizing resource use conflicts while simultaneously keeping impacts on biodiversity as low as possible [43, 44]. The study adopted a schematic methodology to collect data from representative stakeholders (fishers, tourism sector agents, government officials, local and international researchers, private and community actors) to set out guidelines for the establishment of LMMA's as a strategy for better coastal and marine protection. At the same time, this study assessed how and to what extent the local populations can be effectively involved in the management of the area and identified modalities for minimising resource driven conflicts, which may have serious impacts on biodiversity as well as the socio economy of the region. In addition, conscious effort was made to capture data, information, and knowledge from various stakeholders' groups. One key highlight from the socio-economic survey analysis show that fishermen fully depend on fish and have low income [43]. Tourism operators have high incomes and depend mainly on coral reefs and megafauna. A big socio-economic gap between these two sectors makes collaboration difficult and results in conflicts. Another outcome of the feasibility assessment was: "If the collaboration and communication between [fisheries cooperatives], tourism operators and the government is enhanced, the basis for a LMMA would be set" [43]. It was noted that LMMA would benefit the region by coupling government support and funding with the fisheries cooperatives' and tourism operators' knowledge about local marine resources.

The comprehensive assessment helped stakeholders to understand the vision locals have for LMMA's to identify and define challenges to implementing this concept. Most responders agreed that compared to existing management frameworks for coastal and marine ecosystems, such as Marine Protected Area or ICZM, are more of a top-down approach where government takes charge of decision making. LMMA's approach is bottom-up wherein local

stakeholders are in charge of decisions on resource systems with government as an advisor. The approach offers potential benefit local people and nature, taking note of demands and visions of the community and providing them the authority to be guardians.

LMMA guidelines for Kenya, which were modified to apply in Mozambique, outline for consideration by local and national authorities the key aspects that will be included in the proposed planning [37]. These considerations include: variability, uncertainty and probable natural changes in the environment, capacity of the ecosystems to produce food, revenues, employment, and essential ecosystem services and livelihood opportunities [37]. Conservation of ecosystem structures, processes and interactions through sustainable management should be integrated to meet the objectives of the proposed LMMA approach. In doing so, the recommended guidelines strongly emphasize that new and innovative management approaches should include analysis of ecosystem services and developing strategies to conserve and/or restore their functions, along with equitable sharing of its benefits.

Table 1: Results of comparative case study.

Country	Year(s) Created	Key Focus & Impact	Goals to Meet	Strengths	Weaknesses
Fiji	Early 1990a	Increase the clam stocks in Ucuivanua Increased village incomes, improved household welfare Increased food security	30% MPAs by 2030	Aligns with existing Indigenous ways of managing resources Scaled up through the FLMMA Network Strengthened collective ownership rights	Need to be combined with top-down support
Myanmar	2017	Improve the health and biodiversity of coral reefs Protect crab and fish nurseries Increase fish stocks Support local livelihoods	Sustainable Coastal Zone Management	Began with a scientific survey to inform decision-making	Hasn't been implemented long enough to know whether it is successful
Kenya	2006	Increase live hard coral cover Increase fish numbers in Kuruwitu	Reduce over-exploitation of coastal and marine resources	Rapid increase in LMMAs across the country due to community buy-in	Lack of education & awareness, marketing, funding, and monitoring strategies Lack of clear legal framework and guidelines to support LMMA implementation
Madagascar	2004	Temporary octopus closures to increase octopus stocks and catch in Andavadoaka, peer-to-peer learning	Durban Vision – triple MPAs in 5 years	Aligns with traditional values around resource management Peer-to-peer learning through training base MIHARI as their first LMMA network	

Mozambique	2006	Balancing needs of fishermen and tourism operators while conserving the environment	Sustainable Development Goals	Local stakeholders prefer this approach to management	Few LMMA's are recognized by the Mozambique Ministry of Fisheries Lack funding
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Discussion

How this study is related to and builds on existing literature

The case studies summarized in Table 1 highlight the factors that contribute to successful LMMA implementation and those which hinder or create gaps. Successful implementation is characterised in many cases by an alignment with local Indigenous ways of resource management (Fiji, Madagascar, and Mozambique), community buy-in (Kenya), strengthening local collective ownership rights (Fiji), learning from others through informal mechanisms or formal LMMA Networks (Fiji and Madagascar), and scientific studies informing the decisions being made at a local level (Myanmar). However, these LMMA implementations were hindered by a lack of top-down support such as legislation and national recognition (Fiji, Kenya, and Mozambique), lack of funding (Kenya and Mozambique), education and awareness, as well as marketing and monitoring strategies to determine success over time (Kenya). Other jurisdictions hoping to implement a LMMA approach to marine resources management would benefit from national/territorial legislation and funding support to ensure that this is successful.

These cases demonstrate the growing appetite amongst communities to move from more traditional, top-down approaches to having local stakeholders involved in coastal and marine resource related management planning. The exclusion of local communities is a serious existing problem, as observed in Kenya, where the exclusion of local communities led to increased depletion of marine and coastal resources. In the Pacific region, LMMAs are taken as an alternative management strategy, especially where governments have comparatively little capacity to effectively manage dispersed, varied, and vital small-scale fisheries. To ensure that LMMAs are as beneficial as possible for local stakeholders, future research needs to focus on testing the effectiveness of LMMAs for improving the activities and sustainability of fisheries (i.e. designed to prevent the loss of benefits), rather than optimizing benefits [45]. Research also needs to improve the understanding of how LMMAs might work in conjunction with centralised management and higher levels of planning to tackle small-scale fishery concerns [15].

Strengths

The case study analysis demonstrates that coastal and marine protection can be achieved through the establishment of LMMAs to counter unsustainable resource use that often accompanies management options that neglect local stakeholder voices in decision-making. LMMA cases demonstrate how and to what extent the local population can most effectively be involved in the management of the coastal areas to balance ecological and human wellbeing. This study examines existing evidence of both the challenges and supports for implementation of LMMAs globally. The use of the desk review method allowed grey literature to be captured as part of the evidence for each case. This paper provides important lessons for implementation of LMMAs in the future in different jurisdictions.

Limitations

This study is a review of existing published and grey literature about specific cases of LMMA implementation. As a result, there are many cases that were not included in the review to make it more feasible. Additionally, there are no cases of unsuccessful LMMA implementation, rather a focus on what factors created barriers to existing LMMAs. Future assessment could examine those implementations that were unsuccessful to determine if there were different factors that were barriers compared to the cases described above.

Implications for policy

As discussed above, policy support for LMMAs nationally and locally is key to successful implementation and meeting both national and international goals surrounding biodiversity, coastal and marine ecosystem health. The joint pledge of the Intergovernmental Platform on Biodiversity and Ecosystem Services (IPBES), for example, calls for innovative thinking to implement strategic collaborations at all scales from local to global [46]. In addition, IPBES deliverable 1c: "Procedures, approaches and participatory processes for working with indigenous and local knowledge systems" highlights the need to define a clear stakeholder engagement policy that accounts for ILK systems while designing and planning future interventions that aim for biodiversity conservation and ecosystem

management[46, 47]. To ensure that nature conservation and management strategies are effective, planners and policy makers should build their approach on existing experiences and embed various value and knowledge systems. When considering the global context of coastal and marine conservation, LMMAs as a management approach can facilitate many nations meet their targets as set out by the UN Sustainable Development Goals. While this document sets out 17 distinct goals, these are interconnected when it comes to practical ways to meet these goals. LMMAs could assist in meeting many of these goals by focusing on conservation and sustainable use of marine resources while using a participatory governance approach. Unlike traditional management options, such as MPAs, LMMAs involve local communities as essential stakeholders in decisions about conservation of marine resources which affects livelihoods and has the potential to impact the resilience and sustainability of coastal communities who rely on these resources to not only survive, but to thrive. Lessons learned from the inclusion of local stakeholder voices in marine management through LMMA implementation can provide important policy insights for other areas of development that aim to improve quality of life and better understanding of human-nature interaction in specific contexts.

Implications for research

Experiences and efforts on LMMAs made by states such as Myanmar and Kenya show further research evaluating the long-term effectiveness of this approach as a community engaging management option will be important to support scalability. Using a SWOT analysis to examine the Strengths, Weaknesses, Opportunities, and Threats involved in each case will allow new jurisdictions to make evidence informed decisions about policy and implementation strategies. Existing experiences from countries that have adopted this approach reflect that LMMAs could serve as a mechanism to initiate tactical partnerships and engagement with stakeholders to deliver better and coordinated efforts to address priority needs. The need for in-depth investigation that leads to generation of evidence on large-scale merits of LMMA remains important to fill data and information gaps.

Conclusions

Innovations in management approaches in various social-ecological systems at the global scale that have been subjected to heavy anthropogenic influence are a positive sign for the sustainability agenda. In that context, LMMAs is a unique management method, which could be expanded to other geographies in the future to ensure that conservation of our oceans and planet is not occurring at the cost of local livelihoods and the complexities of human-nature interaction can be addressed to some extent. This management approach fits well with pre-existing methods of bottom-up management used by Indigenous peoples in Fiji and other coastal communities as discussed in the case studies. The approach recognizes the importance of ILK to the conservation and sustainable use of ecosystems and provides for a participatory mechanism to managing these systems. The lesson learned from the experiences of Arctic wildlife management and resource assessments is that results are much improved when local communities and local knowledge is included as a source of data to help modulate the findings of population science, and to inform management. Additionally, as sea ice melts due to climate change, increasing the opportunities for international interest in the resources contained within the global commons of the Arctic Ocean, the adoption of LMMA management approach will ensure that local interests are not neglected within this changing context.

Given immense dependence of humans on food derived from coastal and marine ecosystems, and more nations outlining strategies for expanding food reliance from these resource systems, sustainable practices and conservation methods are required to suitably use and harvest these resources. It is a firm assumption that fragile coastal and marine resource systems cannot sustain the growing demand using the “business as usual” approach. New approaches, such as LMMAs, can be employed to effectively meet this growing demand without destroying conservation efforts. The success of this approach is demonstrated by the increase of LMMA coverage in Madagascar to over 14 percent of the 3,000-mile coastline in just 15 years and by the productivity of related aquaculture initiatives.

LMMAs could be comfortably scaled to jurisdictions in Canada as explained by Newell[48Ch. 2]. The study further illustrated the need of strategic approaches in regions of the Canadian Arctic, such as in Nunavut, where vast reaches of ocean territory are supporting widely distributed wildlife populations whose numbers fluctuate and are difficult to estimate. There have been many instances in the past of scientists disregarding local knowledge of the abundance and distribution of marine and other mammals and many management interventions have lacked community involvement or participation. It is important going forward that in jurisdictions, such as Nunavut, where legal commitments to inclusion of local people and local knowledge in decision-making processes exist, that additional means of actioning these requirements are developed. It is anticipated that further development of

LMMAs can offer additional tools to honour the spirit of the Nunavut Land Claims Agreement, and to implement it more effectively in these areas of concern.

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