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Defragmenting resource management on the southeast arm of Lake Malawi: Case of fisheries

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The southeast arm of Lake Malawi catchment has a wide range of natural resources that require prudent management for sustainability and maximisation of benefits. The current management practice is government sector based, with individual Departments and Ministries using their own policies, legislations and management approaches, yet dealing with the same composite resource and user communities. This has resulted in fragmentation of management leading to the lack of alignment between formal and informal institutions, and competition for power and authority for management. Fragmentation is also leading to loss of resource rent. This article analyses how and why management is fragmented in the southeast arm of Lake Malawi catchment and suggests how management could be defragmented, with special interest on fisheries. Activities with high negative impacts on fisheries include: overfishing; soil erosion resulting in siltation and turbidity of the lake; chemical and organic pollution; loss of access to land and beaches; and habitat loss. There is need for a better and more holistic understanding of how human activities represent both livelihood benefits and a threat to sustainability of natural resources to find ways for balancing these two aspects. We suggest that to increase the efficacy of management of Lake Malawi's southeast arm will require 'defragmented decentralization', an approach whereby devolution of authority and responsibility are ceded to the district and local levels, respectively.

Keywords: institutions, fragmentation, defragmented decentralisation, devolution

Introduction

The utilisation of common-pool resources is drawing wide interest and debate because of the multiple uses by a broad range of stakeholders. Population growth, urbanisation, growing demands for food and natural resources, improvement in technology and changing life styles and living patterns continue to increase the impact by humans on natural resources. In many cases this has led to overexploitation of the natural resources. Overexploitation often creates divisions and conflicts

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among traditional user groups and other stakeholders (Ostrom, 2007a). In some instances, people have been able to devise solutions to the problems of overexploitation (Agrawal, 2001; Ostrom, 2007a). When people are unable to find solutions it is usually because the problems cut across spatial and temporal scales, or involve issues of diverse cultural and legal systems with no intrinsic tradition of cooperative behaviour (Jamu et al., 2011).

Here we analyze the types of, and reasons for, fragmentation of resource management in the case study. Fragmentation in commons management occurs at different levels, for example: technical expertise may be split among government management agencies, NGOs, and universities; resource management activities may occur across different geographical scales; natural resource authorities are found in different agencies, and may work across local, national, and international borders as well as across networks (e.g. those in fisheries interact and work with others in fisheries, those in forestry interact and work with other in forestry, etc.). The problems facing the Southeast arm of Lake Malawi (SeA_LM) (see Figure 1) therefore cut across scales spatially, temporally and administratively (vertically and horizontally).[1] The SeA_LM ecosystem is fragile and if not managed effectively could lead to loss of its many beneficial uses.

Interaction and interconnectedness among the various resource components–i.e. land, beach, water, fish, wildlife, forests, and birds–are recognised. However, in most cases these resources are managed as individual sector entities. Management of natural resources in Malawi is fragmented vertically and horizontally. The former refers to fragmentation within a sector (e.g. at various administrative levels such as national, regional and district), while the latter refers to situations whereby communication between sectors (e.g. Departments of Fisheries and Forestry) is incongruent. Thus Ministries and Departments are administratively set up in hierarchical order (with national, regional and district offices) and also each Ministry or Department have their own specific mandates and agendas to guide them in managing specific resources based on their policies

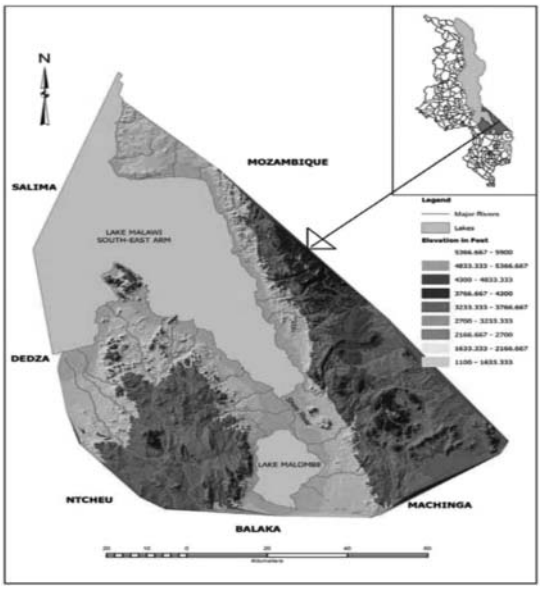

Figure 1. Topography and drainage pattern of the southeast arm of Lake Malawi catchment (source: Department of Surveys, GoM, 2013).

and legislation (Rogers, Nunan, and Fentie, 2017; Hara, 2008). But what happens in one sector is related to and has an impact on other sectors. For example, the clearing of forests for agricultural activities and use of wood for fuel and fish processing, etc. are of concern to forestry authorities. In addition, deforestation, for whatever purpose, results in erosion and siltation in the lake affecting fish productivity.

Malawi's National Environmental Action Plan (GoM, 1994) was developed to harmonise the interests and management agendas of the various stakeholders. The Plan promotes the sustainability and the health of the environment in Malawi, and considers the numerous challenges that exist between the objectives of economic growth and environmental conservation. Despite the action plan, management of resources in Malawi continues to be fragmented. There is a lack of coordination in planning and management and a disjuncture among and within policies and the various pieces of legislation. In most instances, there is also lack of capacity to implement existing policies. For example, in the fisheries sector, the implementation of co-management regimes was assumed to benefit the resources and their users, but recent empirical studies (Weyl, 2008; Béné et al., 2009; Njaya, Donda, and Béné, 2011; Hara, Donda, and Njaya, 2002) have

[1]On the problem of scale in the management of environmental resources see Holling (1995), Lemos and Agrawal (2006), Cash et al. (2006), Berkes (2007).

highlighted the potential problems that may arise from such natural resource governance reforms due to lack of capacity and resources. Their analysis of fisheries sector co-management arrangements in Malawi also shows that problems arise particularly around power distribution, i.e. determining who is responsible for what among the various role players in co-management arrangements, as played out in Beach Village Committees. Specifically, the roles of the key partners such as fishers, traditional leaders and the Department of Fisheries are imprecise or conflicting. Despite enabling policies and legislation on devolution of authority and decentralisation, the norms of centralised management remain deeply ingrained in most officials in Government Departments (Chinsinga, 2005). Others suggest that policy makers should adopt integrated management planning that considers the diverse interests in the natural resources, as well as the ecological, socio-economic and external factors threatening sustainability of ecosystems and livelihoods of dependent communities (Jamu et al., 2011). This article analyses the types of, and reasons for fragmentation of resource management of complex socio-ecological systems and proposes solutions for defragmenting resource management in Malawi using the SeA_LM as a case study. The study was one of several undertaken in different countries in Southern Africa as part of the 'Defragmenting Resource Management in Africa (DARMA)' project whose objective was to build networks and research frameworks for integrated resources management.

Methodologies

Four approaches were used to analyze the SeA_LM as a Social-Ecological System[2]: issue identification and analysis by a network of cross-disciplinary scientists, literature reviews by the fore-mentioned scientists, key informant interviews and Action Research[3]. Firstly, we identified and organized a core group of cross-disciplinary and subject matter specialists from various scientific and work disciplines familiar with, working on, and knowledgeable about the SeA_LM as a composite multiple-use commons. Seven key specialists were identified as follows: 3 from the University of Malawi specializing in Ecology, Forestry and Socio-economics; 3 from the Department of Fisheries (one fisheries economist, one fisheries biologist and one limnologist); one from the Department of Land Resources, an Agriculturist, from the Ministry of Agriculture and Food Security. These scientists identified and analyzed key issues and interactions underlying the utilization of the SeA_LM as a Social-Ecological System through a series of scientific meetings and workshops. Literature reviews based on scientific (both natural and social) and grey literature currently available were undertaken to address cross-sectoral interactions by this same core group of scientists. Critical areas identified as relevant for review of the SeA_LM were: Historical settlement patterns and conflicts; the ecology, the limnology, pollution, siltation, and habitat changes; the fishing, management, and related conflicts; forestry management in the catchment area; the economy of and livelihoods of the inhabitants; and the institutional structures for governance.[4] The reviews were then presented to key stakeholder groups utilizing the SeA_LM to provide opportunity for comment and inputs and to identify the issues for Action Research. The stakeholder groups comprised of members of the District Assembly, District Departmental and Ministerial officials, NGOs working in the natural resource sector, and owners of resort establishments. Action Research was then undertaken with Beach Village Committees and selected representatives of communities on the SeA_LM (at Makawa, Mpondas, Namalaka and Makanjira) to analyze the interactions and the impacts of these at this level, which is the level where they are felt most. Engagement with communities was also important to identify conflicts that arise in the utilization of the SeA_LM as a multi-use composite common and to stimulate thinking about corrective actions among the resource users. The results from this study are therefore based on management issues identification, literature reviews of available knowledge and information, interviews, and action research.

[2]Social-Ecological System is used in the same sense as in Ostrom, Janssen, and Anderies (2007).

[3]A reflective and flexible approach to progressive problem solving that is led by facilitators to improve the way issues are addressed or problems solved.

[4]These reviews have been reported in Donda et al. (2014).

Table 1. Level of interactions between resources and activities on the Southeast arm of Lake Malawi (source: Donda et al. 2014, p. 151) rated as Low, Moderate or High.

Resource / Activity	Fishing	Deforestation	Agriculture	Tourism	Water quality
Fish	High	High	High	High	High
Water level	Low	Moderate	Moderate	Low	Low
Forest	Moderate	High	High	Low	Low
Land	Low	High	High	Low	Low
Beach	Moderate	Low	Low	High	Low
Birds	Low	Moderate	Moderate	Low	Low
Wildlife	Low	High	High	Low	Low

Results

Critical ecosystem interactions associated with the SeA_LM were identified as cutting across seven key resource groups: fish, water, forest cover, land (upland), birds, beaches and wildlife. Table 1 (see Donda et al., 2014) shows where there are sectoral interactions of activities that need management integration according to stakeholders' opinions indicated by the level of intensity that the stakeholders felt there was between the two activities in question. The intensity of the interactions is indicated by three broad levels–high, medium and low. According to the respondents, fishing, tourism, forestry, and agriculture activities interact with fisheries. Also, the lake's water (level and quality) is important for fisheries, tourism and irrigation. Regarding the need for management action, it was agreed that those activities with high impacts need immediate action; those activities with moderate impacts need to be monitored; while activities with low impacts need only to be noted at present. For the purposes of the present discussion, activities with high impacts on fisheries were chosen for critical analysis. The rest of this article thus focuses on interactions between fish as a common pool resource and the key commons utilisation activities in the lake that were judged to have high impacts on fisheries.

Activities that interact with and have high effects on fisheries

Fishing

According to fishers, managers and other stakeholders, fishing activities have had the biggest impact on fish populations in the SeA_LM. Being the most productive area of Lake Malawi, the Southeast arm attracts very high fishing effort, including commercial trawling (in fact the southern tip of the SeA_LM south of Boadzulu Island (Area A), (see map 2) is permanently closed to pair trawling since 2004 while artisanal fisheries are closed for beach seining between 1 November and 31 December in order to alleviate overfishing and allow for recovery of the fishery (Turner, Tweddle, and Makwinja, 1995; Turner, 1995; Banda, Tomasson, and Tweddle, 1996). Given that small-scale fisheries are managed as open access and commercial trawling is managed through limits on the number of units that are allowed in Area B (the area north of Boadzulu Island) (see Figure 2) without limitations on output, this uncontrolled increase in fishing effort has had a great impact on fish resources. The decline of the Chambo, the most valuable species, to levels less than 10% of its production at the height of its productivity in the 1980s (Donda and Hara, 2014; Hara, 2006) is evidence of this heavy exploitation of the area. The macro-economic policy that has always considered fisheries

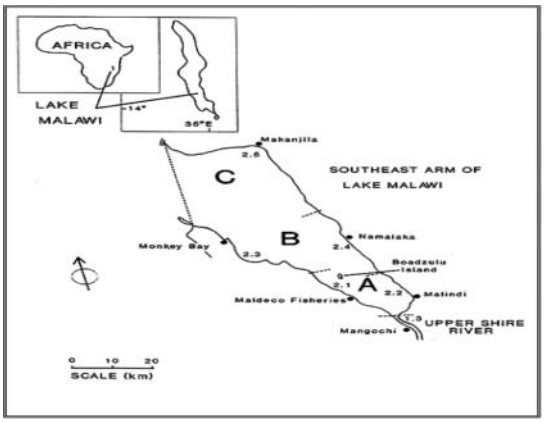

Figure 2. The southeast arm of Lake Malawi showing demarcated fishing zones and main settlements. Modified from GOM/FAO/UNDP (1993).

as a business sector and a source of livelihoods and subsistence that should be left open to entry for anyone with capital is thus seemingly at cross purposes with fisheries management policy that aims to achieve sustainable exploitation through Maximum Sustainable Yield management strategy as stated in the National Fisheries and Aquaculture Policy (GoM, 2001).

Although the intent of the Department of Fisheries in implementing the Lake Malawi Artisanal Fisheries Development Project was to increase fisheries production through the exploitation of offshore fisheries (estimated at 34,000 tons yr^{-1}, (Thompson and Allison, 1997), the project, unintentionally increased levels of fishing effort in the Southeast arm as some of the beneficiaries are still operating in this area rather than moving to the northern district areas of the Lake. The policy should have reduced fishing effort in this area by implementing a strong monitoring control and surveillance system. The use of output regulations (quotas) in the commercial sector and also rights-based fishing in the small-scale fisheries may be the most preferable option in the future to avert the decline of fish species and promote the recovery of the Chambo (Hara and Njaya, 2016). The fact that the Department of Fisheries cannot even enforce existing regulations due to inadequate resources and the structural organisation of the small-scale sector makes rights-based fishing and user involvement in management even more pertinent.

Deforestation

The magnitude of forests within the SeA_LM catchment is declining (Kamoto, 2014). According to Government of Malawi (GoM, 2006) influx of Mozambican refugees into Malawi between 1986 and 1993 resulted in over-exploitation of forests at the behest of human settlements. This is more pronounced especially on the SeA_LM's east bank catchment (Makanjira and Namwera area) since this area borders Mozambique. Government's recent initiative known as 'kudzigulira malo' whereby people relocated to Mangochi from the southern districts, such as Thyolo, Mulanje and Chiradzulu, is also contributing to the depletion of forests as immigrants open new farm lands and construct dwellings. Thus refugees from Mozambique and internal migration from other districts have contributed to deforestation both in the Government Forest Reserves and the Customary Land Forests (Kamoto, 2014). The loss of forests and vegetation cover is leaving most of the soil exposed to soil erosion. Potential effects of increased sediment loads on aquatic communities include increased water turbidity, which results in reduced light penetration and suppression of photosynthetic rates and reduced food availability (Rusuwa, Maruyama, and Yuma, 2006; Ngochera, 2014), effects on fish mate choice, reduction of habitat complexity, destruction of spawning grounds (Lévêque, 1995), and a shift from displaying territorial and courting behaviours to foraging behaviours (Gray, Sabbah, and Hawryshyn, 2011).

Agriculture

Human population growth, as well as increased rates of habitation and agriculture in the SeA_LM catchment, has augmented the demand for land (Matiya and Donda, 2014). The increase in tobacco estates, especially in the Namwera and Makanjira areas, has also increased the rate of deforestation through establishment of these estates and also tobacco curing (Kamoto, 2014). Vegetation along the shoreline, which offers several advantages to fish as breeding areas and spots of refuge for juvenile fish, have been and continue to be cleared, exposing young fish to predation. Removal of vegetation is reducing the catchment's filtering capacity for particulate matter and nutrients from agricultural runoff. Deforestation, biomass burning, destruction of wetlands in the catchments for agricultural purposes, and the cultivation of marginal areas such as steep slopes of hills, is resulting in massive quantities of sediment being eroded from clear-cut watersheds discharging into the rivers and eventually into the lake (Bootsma and Hecky, 1993). This results in the blanketing of benthic algae and disruption of the feeding patterns of the specialised aufwuchs eaters i.e. the rock-dwelling Mbuna that have limited mobility and migration capacity and whose food web is based on benthic algae growing on rocks (Ribbink, 1991). The government's Green Belt Initiative could be a source of new nutrient enrichment into the lake if not properly planned. Nutrients from fertilisers that will be used in the proposed farms around Mpondasi area (under the Green Belt Initiative) have the potential to enhance eutrophication of the Southeast arm if buffer zones which filter particulates and retain

dissolved nutrients are not constructed and maintained.

Tourism

Beach

Resort developments along the shores of the lake is increasingly reducing fishermen's access to many launching and landing sites especially on the south-western shores due to easy access to this area by tourists due to a good road network (compared to the eastern shore). While fishers use the beaches for launching, landing and marketing of their catches, cottage and hotel owners use the beaches for recreational purposes. These two uses of the beach are not usually compatible and in most cases fishers are not allowed to land their catches in front of the cottages and hotels. This is thus increasing competition and conflict of interests in the usage the shore areas and beaches on the western shores of the SeA_LM. In most instances, hotels and private cottages fence off their areas and extend the fences right into the lake, which is illegal under existing law that requires fences to extend only up to 30 metres above the highest water mark.[5] Unfortunately, the Fisheries Department does not have control over these lakeshore developments since the allocation of land for these developments falls under the jurisdiction of the Physical Planning Department. In areas where beaches fall under customary land, chiefs and village headmen have been known to give away or sell land for development at the expense of their people. It is not clear as to whether even customary land should be under the jurisdiction of the Department of Physical Planning or the local (Mangochi District) council in terms of decisions regarding its allocation for economic development. This is sometimes done on the premise that such establishments and developments will create employment for the adjacent communities. At the minimum, government should have some advisory role with chiefs in such matters. Whether such trade-offs for jobs are worth the loss of easy access to the beaches for both fishing and domestic use is a matter for debate. In any case, there is never any real guarantee for jobs for the local communities that lose their land/beaches, let alone that the communities that are directly impacted upon will be prioritised in terms of employment by the establishments that have taken over their land.

Waste disposal

Another effect of tourism development is sewage and solid waste disposal. The Mangochi District Council does not have a sewage disposal system outside the town areas (Mangochi and Monkey) for solid waste disposal. Thus, holiday resorts must construct their own sewage and solid waste disposal systems. It is a matter for concern that these might end up in the lake, posing health hazards to humans and pollution of the lake. Given that the Mangochi District Council or local government do not have the capacity or the systems for certifying and monitoring these sewage and waste disposal systems, this is a source of real concern as these developments continue to flourish without environmental impact assessments and monitoring controls.

Birds

Boadzulu Island in the SeA_LM is home to many types of birds, including the kingfisher, fish eagles and cormorants. While the main source of food for the birds is fish, the fish also benefit from bird droppings as a source of feed and nutrients for primary production. These birds are a tourist attraction for visitors who travel to the island. However, the use of speedboats within the area creates conflict with local fishers especially when boats damage fishing nets or when engine propellers are damaged while caught in fishing nets.

Water quality

The availability of abundant and good quality water is essential for fisheries production. Water level fluctuations in Lake Malawi that might pose a threat to fisheries production are minor now. The total volume of Lake Malawi is approximately 8,000 km^3, while the amount of water leaving the lake through the Shire River and evaporation is less than 1% (Bootsma and Hecky, 1993). However, climate change could affect this balance. The quality of water in Lake Malawi is still in relatively good condition, although effects from sedimentation/siltation and nutrient enrichment from farmlands may cause deterioration. Pollution of water can result from several factors, including mining,

[5]This regulation, mandated by the Town and Country Planning Act (GoM 1991), was put in place in order to allow the public and communities access to and use of beaches for fishing and domestic purposes. However, some cottage owners fence their plots to maintain privacy and for security purposes.

through both the introduction of chemicals as well as through increased loading of suspended solids. The newly established cement manufacturing company (Njereza Cement Company) at Makawa could be a new source of pollution if the operations are not properly planned and monitored. Other factors include agricultural activities–through the introduction of pesticides and chemical fertilisers; tourism and domestic waste–organic pollution from sewage effluent (e.g. increased nutrient loading and faecal coliforms); urbanisation–sewage effluent and industrial effluent; and aquaculture–the introduction of intensive cage culture (especially from unconsumed fish feed). Other potential threats to water quality include: nutrient loading from inflowing rivers and atmospheric deposition.

Discussion

Impacts of fragmented management

Important aspects of fragmentation in the management of fisheries and other resources on the SeA_LM relate to institutions and governance. Formal policies and legislation are not aligned. As noted above, tourism development is affecting access to the beaches for fishing and domestic uses by communities. Agricultural activities are having an impact on forest cover, soil erosion and siltation/turbidity of the lake. In addition, formal government policies and regulations are not necessarily in line with informal and customary norms and practices. For example, traditional chiefs have powers over customary land, forests and fishing activities in their areas. While these powers are meant to be exercised in support of their people, some chiefs give away or sell land and beaches, limiting or even denying their people access to and use of such resources. With respect to the powers of traditional chiefs over natural resources, there is at times a grey area surrounding their powers and those of government (Donda and Hara, 2014). This has become a real issue along the lake regarding the use of customary land for developments such as holiday and private resorts. Where does the limit for chiefs to give or sell such land and beaches end and where does government's responsibility and role begin? This is also a concern about access to public land along the lake.

The role of chiefs in co-management arrangements is unclear (Kamoto, 2014; Hara et al., 2014). In most instances, there is competition for power between local chiefs and local organisations that are supposed to be vehicles for user participation in co-management of natural resources such as Beach Village Committees and Forestry Natural Resource Management Committees. The question has become whether these organisations should be independent of, or fall under, local chiefs. To the extent that they are considered separate power brokers, local chiefs see these structures as a threat to their authority and therefore would like to have control over their functioning. Meanwhile, local user representative management organisations regard themselves as being independent of the jurisdiction of local chiefs. This appears to be tacitly supported by government departments that are partners with the local committees in the co-management arrangements. Government departments view the need for strong independent committees as a prerequisite for devolution of management authority and responsibility to local committees. But if local committees are eventually to assume management responsibilities, it is likely that they will require the use of traditional authority powers for the application of sanctions at local level, unless they will be required to become honorary government entities and apply the formal regulations with sanctions being applied through magistrate courts (Hara et al., 2014; Hara, Donda, and Njaya, 2002). This dilemma and competition for power between local management committees and their chiefs continues to hamper progress towards functional co-management. At the same time, it may be the seed for a necessary division of legitimate power at the local level.

Weak institutional and legislative oversight is another factor resulting in fragmentation of management. Most departments and ministries are unable to enforce even existing regulations. For example, one of the reasons for over-exploitation of the Chambo fishery (Donda and Hara, 2014) and the continuing devastation of both customary and public forests (Kamoto, 2014) is the lack of resources for enforcing regulations in the responsible departments. This is one of the reasons for the move to devolve authority and responsibility to local communities through co-management and user participation. The thinking is that by making user communities partners in the management of resources that they depend on for livelihoods, better management outcomes will be achieved.

Administrative decentralization

To defragment management and shift towards more coherent, sustainable resource utilisation, several reforms need to be undertaken. There is a need to implement administrative decentralisation whole-

heartedly rather than in the current piecemeal fashion. The proposed decentralisation policy and legislation (GoM, 1998a,c) were based on principles of bottom-up planning whereby communities decide and prioritise issues and aspects of development in their areas. Regarding resource management, each district is supposed to have the capacity to develop and pass locally relevant and applicable regulatory by-laws for its district and specific local areas provided that these are aligned to national legislation (GoM, 2004, 1996). In this context, the revised Fisheries Act provides authority for the formulation and passing of by-laws to District Assemblies, in line with (but not in conflict with) the main Fisheries Act (GoM, 1997a). Such local and then district-level planning would also recognize a district's strengths and opportunities while mitigating threats and weaknesses. Budget allocation decisions for both development and management of natural resources would also be implemented at the district level. Other positive aspects regarding decentralisation include coordination of development by the District Commissioner and coordination of environmental management by the District Environmental Officer (Hara, 2008). Each district could develop locally based reward and sanction systems combining both formal and informal systems (based on the powers of traditional authorities) for resource management as part of the capacity to develop and pass by-laws. However, local elections have been held only once since decentralization policy and legislations were passed in 1998 (GoM, 1998a,c; Tambulasi, 2011). Resistance by government departments to giving up authority and responsibility to District Assemblies is one of the main reasons for the slow implementation of decentralization (Hara, 2008). But it should also be noted that there may be valid reasons for some caution regarding decentralisation. Local "elite capture" may for example threaten to negate the intended positive benefits. Thus, a facile explanation often heard for the lack of government action in general is 'lack of political will'. The same explanation has also been heard about lack of decentralisation. But this explanation fails to ask why there is a lack of 'political will'. In democratic states one often sees that political will comes with political and administrative ability to act. Maybe the context, including both culture and formal institutions, is not yet ready? More generally it has been found that consequences for the power base of the currently ruling factions will determine political will. There is no "will to act" in ways that will diminish the resources and incomes of the ruling groups even if the welfare of the public is sacrificed. This leads for example to persistent paths of economic under-achievement (North, 1990, 2005, 1994; Acemoglu and Robinson, 2012).

Devolution of authority and responsibility: Design principles

There is an important distinction between decentralisation and devolution of authority. The former refers to the delegation of authority and responsibility from higher levels to lower levels of government while the latter refers to relinquishing power (authority and responsibility) from government to locally elected assemblies or users (Carlsson and Sandström, 2008; Hara, 2008; Adam and Kriesi, 2007). Generally, governments can tolerate delegation, but will often fight against any proposal for devolution of power since the former relates to maintaining power within government, albeit at lower level, while the latter represents transfer of power from government to non-government entities. The design principles for well-functioning resource governance institutions (Ostrom, 1990, 2005b) suggest strongly that granting local bodies the power and right to change operational and collective choice rules at the community level (i.e. real devolution–principle 7) may be a minimum condition for successful co-management or user-management of natural resources. In thinking about the problems that need immediate attention (High effects problems) we should be guided by these design principles. Adherence to the principles is not an all or nothing choice, but a question of degree. The basic rule: 'There are no panaceas for successful resource management' (Ostrom, Janssen, and Anderies, 2007) must be kept in mind. In addition, Cleaver (2002, 2012)'s arguments about the need for 'institutional bricolage'[6] would need to be considered seriously when formulating institutions for collective action on the SeA_LM given the diversity of users and uses, values, culture, and traditions attached to

[6]Cleaver (2002) uses the term 'bricolage' to refer to "how mechanisms for resource management and collective action are borrowed or constructed from existing institutions, styles of thinking and sanctioned social relationships" (p. 16). Also, this concept argues that existing arrangements are usually adapted for multiple purposes, are embedded in networks of social relations, norms and practices, and in which maintaining social consensus and solidarity may be equally important as optimum resource management outcomes (p. 17).

the resources. Arguments for decentralisation and devolution are often strong, but these approaches are no panacea either. There are tasks and functional requirements that only a central coordinator may perform. This is recognised by the ideas developed in the theories of co-management and adaptive co-management (Carlsson and Berkes, 2005; Berkes, 2009; Bown, Gray, and Stead, 2013). The "fact is that co-management and adaptive co-management are laudable objectives, but very difficult to implement in practice" (Bown, Gray, and Stead, 2013). Reformers would do well to remember that "rules are not self-formulating, self-determining, or self-enforcing" (page 312 in Ostrom, 1980, p. 312). People are doing all these tasks and carry along their personal biases in doing so. In a process of designing institutions one needs to be aware that the process of developing the rules is as important for the result as the rules themselves. The exact same rules will work as intended in one instance where the users of the rules have participated in their development and will be quite ineffective in another where the rules have been promulgated top-down. The phenomenon has been labelled the 'crowding out' effect (Cardenas, Stranlund, and Willis, 2000; Ostrom, 2005a). Legitimacy of rules and moral commitment to following them are very important for the resulting exploitation of the resource. The problems experienced in institutionalising functional co-management arrangements in Lake Malawi and the Upper Shire River can be mainly attributed to a top-down approach in the introduction, facilitation, and implementation by government (Njaya, Donda, and Béné, 2011; Hara, Donda, and Njaya, 2002; Hara, 2001). These lessons will need to be borne in mind when coming up with workable collective action arrangements on the SeA_LM. Ostrom (2007b) advocates a diagnostic approach in selecting appropriate starting points for reforms of institutions for resource management. This is what we have attempted here in surveying the Social-Ecological System of the SeA_LM and focusing on the problems that need immediate attention. Empirically, the closer a system comes to following ideal design principles the more long-term sustainability can be observed until some external force (e.g. new markets; new technology; climate change, etc.) creates a new dynamic. Then a new cycle of adaptation of the internal institutional structure follows or emerges. What we need to think about is how to speed up the cycle of adaptation based on knowledge of external forces, which local users seldom know much about (Berkes, 2009). This might, for example, include long-term shifts in relative prices on the market for food, large-scale relocations of populations or changes in the ecological conditions, etc. Thus the introduction of improved technologies such as nylon nets, motorised boats and improved linkages to expanding urban markets from the 1970s onwards resulted in increased commodification of fisheries, without the requisite institutional arrangements for controlling and dealing with increasing fishing effort on a finite resource (Hara and Jul-Larsen, 2003; Hara, 2001).

Effective use of scientific knowledge (both natural and social) will in the long run depend heavily on the trustworthiness the scientists involved. If they are suspected of providing selective information or bias in favour of some definable sections of stakeholders, their advice will be of no actionable value to local decision makers regardless of the accuracy of their information. Concerns of fishers on the SeA_LM regarding loss of access to beaches, equitable application of the closed season between them and commercial trawlers, destruction of their gears by trawlers or sport speed boats, and increased threats to loss of offshore fishing area because of the introduction of cage culture practices need to be taken very seriously by scientists assessing their impacts. There is need to develop a mechanism that translates science into useful information that will eventually enhance and support conservation by and for the people. Community awareness and educational programmes should link researchers and stakeholders, so that research findings are explained, presented and shared with the users.

The problem of institutional design for the exploitation of the SeA_LM as a Social-Ecological System is complex given the multiplicity of users and uses. The practical approach must be to acknowledge this complexity even as one uses the simplified models presented by Donda et al. (2014). There is need to list and describe relevant variables for understanding the resource system (RS), the resource units (RU), the governance system (GS), and the users of these systems (U) (Poteete, Janssen, and Ostrom, 2010; Ostrom 2007b) in order to decompose (Wilson, 2002; Ahl and Allen, 1996; Allen and Hoekstra, 1992; Koestler, 1973) these for analysis. Even more importantly, we need to be specific about related ecosystems and social, political, and economic settings. To be realistic about what can be achieved we need to understand environmental parameters, including the power dynamics of established bureaucracies, opportunity structures created by existing markets and

possible changes in market access, availability of new technology, and the presence of opportunistic strategies among all classes of stakeholders. The dynamics created by these parameters can be met and neutralised or enhanced by appropriately designed institutions. An important part of any effective institution is monitoring and enforcement, but proposals for reform should include options for self-monitoring, giving local stakeholders both authority to act and sufficient information to understand when self-serving actors stray from the goals agreed upon. In practice this means a high degree of open access to information of all kinds. The studies so far undertaken on Lake Malawi fisheries raise one core problem–the inequality between an efficient fishing effort depending on motor boats and modern equipment and traditional fishing methods. One way to address this could be to develop quotas for each boat with a motor, and to register and monitor such boats (Hara and Njaya, 2016). Thus, a low-cost way of achieving this would be to enlist small-scale fishers in monitoring and possibly some low-level sanctioning. However, this requires that the fisher community has participated in the design of the rules, including the quotas, and accept them as a reasonable way of securing fish for all. It also assumes that the motor boat community does not have sufficient lobbying power in Parliament to block the legislation.

Concluding recommendations

The findings of this study indicate that decentralisation of authority and responsibility to the community level could help defragment management of natural resources in the SeA_LM, especially if this is based on a process of delegation of authority and responsibility to district level, and then devolution of authority and responsibility to community level. The fact that all the government sectoral extension agents working at grassroots level (who are controlled at district level) target the same communities strengthens the argument that such an approach would be the best way to proceed. This would require bottom-up and transparent planning and coordination at community level by the extension agents and their controlling officers at district level. Fragmented decentralisation, whereby management is decentralised but fragmented, is the situation currently existing on the SeA_LM, largely due to a lack of functional presence on the ground of most government line agencies mainly because of budgetary constraints. Based on our findings, the ideal mode of management to ensure sustainable utilisation of the SeA_LM as a composite natural resource complex is 'defragmented decentralisation' based on the relevant aspects of 'design principles' (Ostrom, 1990, 2005b) and 'institutional bricolage' (Cleaver, 2002). This could be achieved through a working and empowered District Assembly based on the proposed principles of administrative decentralisation and devolution of power to empowered Beach Village Committees designed appropriately for the area and embedded within the social, cultural and economic ethos and practices of user communities. In the proposed administrative decentralisation, once implemented and working, the District Assembly would be able to formulate and pass by-laws appropriate for the SeA_LM.

As demonstrated in this article, numerous issues need to be addressed for sustainable utilisation of natural resources to take place, including obtaining accurate valuation of the natural resources. For example, although the importance of fisheries to the economy, livelihoods, ecology, and culture of the SeA_LM is widely recognised, there is still inadequate understanding of its actual estimable value, particularly in communities where fishing is the main mode and source of meaningful livelihoods (Hara and Njaya, 2016). There is therefore a need to place some tangible value on the resources in the SeA_LM to raise the profile of various resource sectors in the area. Attention should be given to the following: (a) determining the quantity and value of natural resources such as biomass of fisheries; (b) livelihoods benefit analysis; (c) social and cultural benefits; and (d) understanding of the extent of poverty and how it impacts or could impact on possibilities of reduced consumption of natural resources in the area. In this context, there is need for a better and more holistic understanding of how human activities represent both a benefit and a threat to livelihoods, and concurrently the ecosystem of the Southeast arm of Lake Malawi as a Social-Ecological System.

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