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Changes in Fisheries and Social Dynamics in Tanzanian Coastal Fishing Communities

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Abstract — Fishing communities constantly change and adapt to modifications in the environment, and are reflected in changes to variables related to the dynamics of a fishery. Such changes in a fishery could involve a decline in fish stocks, market failure or the loss of an important species. The effects of such changes on the social dynamics of artisanal fishing communities have been poorly investigated in the Western Indian Ocean region. This article examines how communities have been affected by recent environmental, technological and socio-cultural changes in fisheries in five coastal villages in the Mtwara rural district, Tanzania, and the mechanisms whereby people cope with these changes. Data were derived from 103 semi-structured interviews, 15 focus group discussions, nine oral interviews, participant observations, and reviews of literature and policy documents. Overall, nearly 80% of respondents declared that there were significant changes in fishing techniques, strategies and the social organisation of the fishers. Almost 60% of the respondents admitted that traditional fishing gear such as traps and hand lines have increasingly been replaced by fishing nets operated from powered boats, especially since the 1980s, to compensate for declining fish catches. There is a shift from collective communal fisheries to individual and private fishing groups due to weakening of social structures and increased monetisation in the fishery activities. New values and perspectives are now being integrated into the communities. Approaches required for understanding and promoting development of fishing communities should include objectives that recognise how social structures adapt in the face of extreme conditions of the fishery.

INTRODUCTION

The interactions between humans and ocean systems have long been recognized as human not only influence ocean systems, but also depend on them for goods and services (Vitousek *et al*., 1997; Halpern *et al*., 2008). The greatest human influences involve resource extraction, especially in

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fishing activities, which are profound in coastal ecosystems (Pauly *et al*., 2005). However, the relationship between human social systems and ocean fisheries is highly complex (Mahon *et al*., 2008) and involves more than the fishers alone (Salas & Gaertner, 2004). A fishery system is defined as a combination of subsystems – comprising those human, the natural resources and their management – that interact dynamically and are influenced by both external and internal factors (Garcia & Charles, 2008). Understanding the interdependency between these subsystems, particularly with regard to the social implications on fishing communities, has remained largely ignored (Salas & Gaertner, 2004).

Small-scale fisheries currently face critical challenges, including global climate change, social and socio-economic development, and vulnerability to natural and human disturbance (Armitage & Marschke, 2013). Social vulnerability to these pressures potentially diminishes the livelihoods, food security, well-being and traditional lifestyles of coastal communities and cultures (Béné *et al*., 2007). As a result, small-scale fishing communities constantly undergo processes of change and adaptation as changes occur in their environment (Cinner *et al*., 2010). The latter are often reflected by changes in field related to fisheries parameters such as fish catch, availability, abundance and stock size (Cinner *et al*., 2009; FAO, 2010). These changes, in turn, influence the social dynamics and structures they are strongly intertwined with (Cinner & Aswani, 2007; Cinner *et al*., 2012).

Some fisheries are undergoing major transformations and development, e.g. the development of distant water fisheries in Taiwan (Chang *et al*., 2010) and the certification of the hake fishery in South Africa (Crosoel *et al*., 2006). Such changes are influenced by increased globalization, fundamental shifts in economic and political power, escalating environmental changes, and unpredictable social conflicts (Olson, 2011). However, rapid processes of socio-political development in the third world have only led to rapid changes in fishing techniques and practices. These have triggered a transformation in the social structures and dynamics that has affected customary practices and traditional lifestyles (Crona *et al*., 2010; de la Torre-Castro & Lindström, 2010).

Despite increasing reports on changes in small-scale fisheries in many parts of the world (Zeller *et al*., 2007; FAO, 2012), detailed information on their influence on development in fishing communities and the associated dynamics are still rare (Bodin & Crona, 2008). In most countries in the Western Indian Ocean (WIO), which is home to diverse coastal cultures (Diop *et al*., 2011), the effects of rapid changes in the natural environment on fishing communities, their fishing practices and social dynamics, are poorly studied (Cinner & David, 2011). This study sought to empirically demonstrate the interconnectedness between changes in fisheries and social dynamics in coastal fishing communities (elucidated through their social structure) in the WIO, using a Tanzanian case study. It was based on concepts derived from the theory of change and coping strategies (Pedroza & Salas, 2011). Historical information on changes in fishing practices and the social components in coastal communities were incorporated. Data collected were assessed relative to the environment in which they were embedded.

Fisheries underlie traditional livelihoods along the Tanzanian coastline, as in other WIO countries (Gustavon *et al*., 2009). They play an important role in a community's social structure and dynamics (Jacquet *et al*., 2010). Recent changes in the demography, economy and level of technology in Tanzania have led to a fast development of its fisheries from 'traditional and non-monetised' to 'artisanal and cash-oriented' (Jiddawi & Öhman, 2002). Conditions leading to the development of fisheries have affected social networks within the communities. For example, developments in fisheries have led to a stronger orientation towards the individual and, as a result, conflict with traditional collective fishing, resulting in the

disintegration of the communal protection of resources. Power structures have shifted from elders to individuals with greater economic influence, eroding the traditional structures. Despite these changes, fisheries continue to be the main livelihood for most coastal people and remain largely intertwined with their social structure.

MATERIALS and METHODS

Study sites

The study was carried out in five coastal villages (Mnete, Nalingu, Msimbati, Mkubiru and Mngoji), all of them located in the Mtwara rural district, southern Tanzania (Fig. 1). All of the villages are located on the seafront

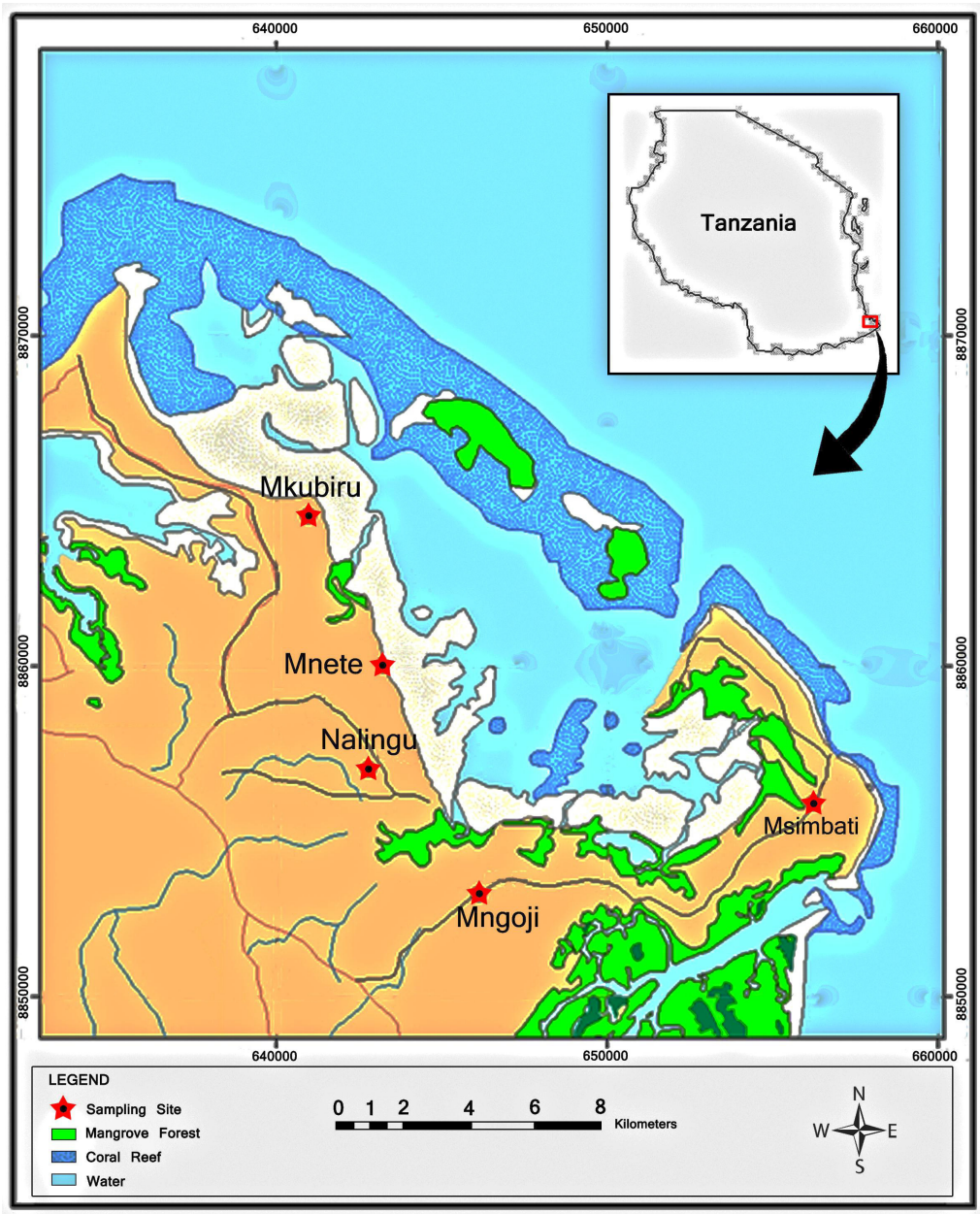


Figure 1. Map of the study sites.

and are situated in a marine protected area (MPA) known as the Mnazi Bay-Ruvuma Estuary Marine Park (MBREMP). The main occupations in the villages are small-scale fishing and subsistence farming (MBREMP, 2011). Nearly 60–80% of the population in the study villages rely on fisheries for their livelihood, for both subsistence and economic purposes (Malleret, 2004). Traditional fishing methods are employed by the communities and include seine nets, gill nets, hand lines, basket traps and spears, operated from traditional dugouts and dhows (Gawner & Muhando, 2004). The study villages were not homogenous in terms of socio-economic differentiation (Mwaipopo & Ngazy, 1998), although the differential gradient between them was perceived by the villagers to be relatively narrow. These perceptions concurred with previous studies on socio-economic differentiation in rural Tanzanian communities (Bryceson *et al*., 2002). However, differences were observable in the villages: mainly subsistence-based fishing was found in Mngoji and Msimbati, and more semi-commercialized fishing (using ring nets and bigger, powered boats to fish beyond Mnazi Bay) in Mnete and Nalingu. The villages, therefore, provided ideal conditions for a comparative analysis.

Rainfall in the Mtwara region is generally low, usually between 500–1 000 mm per year, with more precipitation falling over a short period from April to May. This falls in one of the two monsoonal rainy seasons in the region which occur between November to December and February to May (URT, 2005). The mean monthly temperature varies from 23–27°C and the relative humidity varies from 79–87%.

The villages were populated by nearly 19 000 people at the time of the study. Most houses have mud walls and thatched roofs: few houses have corrugated iron roofs. The major ethnic group is Makonde; the Makua are in the minority. Kiswahili is the most widely spoken language. While cashew nuts and sesame are the major cash crops, cassava, sorghum, maize and rice form the primary food crops (Majule *et al*., 2010).

Each of the study villages was chosen based on three criteria. First was a dependence on small-scale fisheries and proximity to the coast. For example, in Mkubiru village, nearly all the men are engaged in fishing activities and over 80% of all households sustain their livelihoods through fishing (Barr *et al*., 2011; Robinson *et al*., 2012). The second criterion was whether fishers used modern fishing gears such as ring nets and large-mesh fishing nets. The last criterion was the presence of economic opportunities apart from fishing that could reveal differences in the economic status between and within villages. Msimbati village, for instance, is now a centre for natural gas and petroleum exploration. It also used to be the main fish-trading centre, especially for sea cucumber (*Holothuria scabra*), attracting traders from Mozambique (Harrison, 2005). Both of these villages have individuals who venture to Vamizi and Quirimbas islands in Mozambique for two to three months in the year for commercial fishing.

Data collection

The study was carried out between November 2010 and February 2011, and involved qualitative methods of inquiry and the review of relevant literature. A scoping phase was conducted at the outset of the study, after which data were collected using semi-structured interviews, focus group discussions, oral biography interviews and participant observation. Interviews and discussions were held in Kiswahili.

A total of 106 semi-structured interviews were conducted with local individuals who were involved in a variety of aspects of the fisheries within the villages. The interviewees comprised 61 fishers, 23 fish traders and processors, 10 village leaders, 5 members of NGOs working on marine and coastal issues in the Mtwara district, three fisheries officials and four decision makers at the local ward level (two councillors and two ward executive officers). All interviewees were selected a priori so as to get information from people with a sound understanding of the research questions, while including stakeholders from the different

aspects. In some cases, new respondents were identified and contacted following suggestions given by earlier interviewees. Semi-structured interviews were thought to provide data concerning the fisheries over time, as well as vulnerabilities and risks associated with those changes. In the same way, they were directed towards an explanation on how communities were adapting to changes that affected them. Respondents were asked to give in-depth account of the factors that had strengthened or weakened their social structure, and, in turn, the changes that had affected the fishing communities. The interviews further focused on the perceptions of transformation within and between fishing communities attributable to changing social, economic, political, technological, and environmental parameters. The key questions investigated were: How, if at all, strategies for coping with changes in fishery have altered social structure; and how different social dynamics affected the fisheries. Each semi-structured interview lasted for approximately 30-50 minutes.

Using guided themes, 15 focus group discussions (FGD), with 8–12 participants per group were held with community members and village leaders between January and February 2011. These discussion groups were intended to provide or confirm additional information on the linkages between changes in the fisheries and the social dynamics in the coastal communities. They were facilitated using questions on how individuals cope with changes in their fisheries resources over time, their readiness to adopt new technologies, their perceptions the associated social dynamics, and their knowledge of strategies that encourage transformation in fisheries. Three focus group meetings were held in each of the five study villages. Participants in these discussions were chosen based on their gender and know-how of the fisheries and social structures. Their selection was also based on the different livelihood activities including fishing, farming, small-scale businesses, waged jobs and self-employment. Focus group discussions lasted from 40 minutes to an hour. All meetings were recorded and transcribed verbatim in Kiswahili.

In addition, nine individuals 50–70 years old were identified and they related their life histories relative to changes in fishing techniques during their life-time. The idea was that they should tell their stories, in their own words, viewed from their perspective on the interplay between fisheries and social dynamics. Life history interviews were recorded using a MP3 digital recorder and often lasted up to 50 minutes. Throughout data collection, the research team incorporated their observations. They visited fish landing sites, markets and other areas in the villages. This was done to ensure that all social processes and events were considered, including those that may have been otherwise overlooked by the casual observer. Indeed, these observations provided an understanding of the attitudes and perceptions regarding transformation in the fisheries. The study thus used a variety of methods that complemented each other to enhance the reliability of the data and reduce personal bias in their interpretation.

Secondary sources of data included a review of the relevant published and unpublished literature and information on the internet.

Data processing and analysis

Analysis of the data involved triangulation of the information from field notes, transcribed interviews and aforementioned secondary sources. Data were coded according to pre-determined themes (developed intrinsically from the interview texts) and analysed using content analysis (Marrying, 2000) to extract the main findings. The data were further analysed to evaluate the interplay between changes in the resources and social structures, based on the initial situational analysis of the study sites and on fishers' perspectives of a decline in the fisheries resources and the associated social impacts. Additionally, some quantitative (descriptive) results were considered to highlight trends and to provide a working baseline for future research.

RESULTS

Historical overview of the local fisheries

Local fisheries in the colonial era

The period between the years 1884 and 1960, during which the lands that came to form Tanzania were governed by Europeans states, is described as colonial era. Fishing is not a new phenomenon in the study area. However, there is only limited information on fisheries in the colonial period. Over 50% of respondents were able to provide anecdotal information on the size and productivity of the inshore resources. All the respondents at Msimbati, Mngoji and Nalingu admitted that some of the residents in these villages were initially drawn from different family and clans groups located in communities closer to the Ruvuma River, predominantly from farming, hunting, herding, trading and ironworking communities. Among the respondents in both villages, 65% mentioned that people made their living largely from farming, hunting and trade during colonial era. Almost all respondents indicated that the coastal communities had been harvesting marine resources, fish in particular, for ages, though the activities were primarily for subsistence needs using locally made gear such as traps, weirs and hooks. The influence of colonialism on fisheries was minimal, as was pointed out during one of the FGD in Msimbati village:

'The original inhabitants of these villages [coastal] were farmers and hunter-gathers. They lived in areas sheltered against the strong ocean wave; they used traps and hand-made hooks to capture fish in inshore waters. These techniques used for fishing were practised throughout the coastal villages, although there were slight variations in practices across villages and associated marine resources. Despite the disruptions to local people during the colonial period, there is evidence that people adapted their resource use patterns and harvesting methods following influx of markets and begun fishing further inshore to target various fish species.'

The marine resources they harvested were fish, lobsters, sea cucumbers and intertidal invertebrates, the most important being fish. Most of the respondents asserted that the colonialists appeared to put less emphasis on fisheries and fisheries resources use than on forests and wildlife. For example, a participant in a FGD in Mngoji village made this remark:

'Our areas contained rich fish resources. It is anomalous that colonial rulers didn't consider such big values; just as they did in agricultural-predominant areas. There was no infrastructure to the coastal villages, no landing harbours, less fisheries extension officers to impart skills as it were in farming sector. Fishers and their communities remained marginalized.'

The post-colonial era

The post-colonial era is taken to be the period from 1961 to date. Approximately three-quarters of respondents indicated that fishing activities are undertaken with or without a fishing vessel in the near-shore areas for subsistence and income (presumably closer to areas outside Mnazi Bay and around the small islands of Membelwa and Namponda). Respondents indicated that some fishers operate over considerable distances of coastline further south to the mouth of the Ruvuma River, but that most were single day trips. Interviews also indicated that some fishers cross the border to the Vamizi, Rongui and Quirimbas Islands in Mozambique. It is worth noting that few fishers use powered vessels as pointed out in one of the semi-structured interviews:

In one of the semi-structured interviews:

'I have been fishing since 1980s. Clearly many of the fishing activities in all coastal villages of Mtwara are carried out using dug-out canoes (mtumbwi). It is only recently [2007], especially after Marine Park authorities handed out boats and fishing nets to two fishing groups that we started to see youths in our villages engaging in fishing with big boats. Before that, our people transited to Mafia and Kilwa where they worked as labourers for people owning fishing gear and vessels.'

Over two-thirds of respondents expressed their concern at the slow pace of transformation in the fishery, highlighting the predominance of primitive gear from the colonial period. A large proportion of fishers (40–60%) still used hand lines and traditional traps, whereas a small fraction (<30%) have access to fishing nets, particularly of large-mesh nets (4–6 inches). Participant observation revealed that traditional fishing gear such as tidal weirs and spears were still used by a number of fishers, though to a small extent. Entrance into the fishing industry is free to any individual with gear and the time to fish. There is no catch limit; participating fishers can catch as much as they like and their vessel will carry. The government has imposed annual fishing licensing costing about US$ 5.

When asked about the increase in fishing effort compared to the colonial era, 80% of respondents linked this to the rapid rise in the number of fishers and fishing vessels. Local economies have become monetised, forcing economically active residents to engage in fishing and fisheries-related activities, as was clearly indicated during a FGD in Nalingu village:

'In general, most of the income [cash] in our village comes from fishing activities. Only a small percentage [<5%] of the economically active resident household members in our villages derive their income outside fisheries. Our access to other economic occupations is very limited; we have low education level, lack capital and infrastructure, and policy does not support us.'

The Fisheries Act of 2003 is of particular concern as it includes regulations and measures on licensing, closed areas and a ban on certain types of fishing, especially dynamite fishing, drag nets and fishing nets with mesh sizes less than two inches. Discussions in focus group meetings at Msimbati and Mngoji revealed that the use of small-mesh fishing nets and dynamite are the most common infringements of fisheries regulations. Furthermore, over 90% of respondents said that illegal fishing activities were more rampant in Nalingu, Mkubiru and Mnete than Mngoji and Msimbati.

Development and transformation in the fisheries over the past five decades

Over the past five decades, populations in almost all the study villages have increased and fishing practises have changed, affecting the marine environment and transforming the ecosysytems. In the late-1980s, the fisheries changed fundamentally and deleteriously in character. Destructive and illegal fishing activities intensified and environmental awareness campaigns had to be introduced and rapidly expanded in the Mtwara rural district, including the study villages. Deliberations in at least seven focus group discussions identified both environmental and socio-economic factors that contributed to this ongoing transformation in the local fisheries (Table 1). During 1994–1998, dynamite fishing became rampant and caused serious damage to large areas of coral reef, as well as several injuries and deaths to dynamiters, raising grave concern as to the future of the industry. The government deployed the navy and army in 1998 to stop dynamite fishing in an operation known as 'pono'; this caused communities to engage more fully in protecting fisheries resources.

The early 2000s saw a decline in destructive fishing activities, especially after the study area became part of the newly-declared marine protected area, the Mnazi Bay Ruvuma Estuary Marine Park (MBREMP), promulgated in 2002. With the MBREMP in operation, a number of alternative livelihood activities emerged, including the use of large-mesh (4–6 inch) fishing nets, which were exchanged for small-mesh (2–3 inch) and monofilament fishing nets. With declining fish catches, many households were unable to any longer use traditional gear to take advantage of the high market prices for fish. As a reaction to the market, some fishers returned to destructive fishing methods in 2008, with dynamiters in Nalingu, Mnete and Mkubiru engaging in illegal fishing activities.

Local fishing is not subsidised. Access to modern fishing gear and vessels is very limited and fishers need to travel over a distance of 600 km to Dar es Salaam to purchases such equipment as suppliers in the nearby town (Mtwara) are few and their prices are high.

Table 1. Historical events related to changes in the local fishery since 1960s.

Decade	Important event	Example
1960s	Cross-regional trade in marine products	Not yet common because of irregularity of visits by fish buyers dried salted fish, sea shells, shark fins and sea cucumbers.
	Fishing gear	Difficult to readily import boat engines and fishing gear due to foreign exchange limitations.
1970s	Export of marine fish	Trade restricted by government policy aimed at promoting food security at home; however, marine products such as prawns, sea cucumbers, lobster, seaweed and crab were excluded from this policy intervention.
	Fisheries Act of 1970	The above products except finfish were not in high demand locally.
	Support to fishermen	Framework provided for operation and control of all activities in fishery sector.
		Initiation of development projects mostly under donor assistance, e.g. Rural Integrated Development Programme in Mtwara and Lindi in 1979 under financial support of British Oversee Development Agency.
	Number of households engaging in fishing (both directly and indirectly)	Significantly increase.
	Purse seine (ring nets) fishery	Introduced in 1975 by Greek fishermen; operated using light attraction on moonless nights and a hand-hauled net up to 400 m long and 65 m deep.
	Credit	Main sources of credit granted loans purely for large-scale commercial developments.
1980s	Fishing operations	Undertaken in small vessels, or without vessels; variety of changes in fishery, e.g. type and construction of gear and techniques.
	Semi-industrial fishery	Shrimp trawling operated by the Tanzania Fishing Corporation (TAFICO). Pulse seining with light attraction for small schools of pelagic fish.
	Importance of fisheries	Basic need for food and income. Personal values. Only available occupation.
	Restrictive policies	Restrictive policies were reversed with the advent of macro-economic reforms and trade liberalization.
	International regulations	Expansion of coastal jurisdiction into the Exclusive Economic Zone (EEZ).
1990s	Export of fish from the inshore fishery	Fish and fishery products ranked among the top five exports in Tanzania.
	National fisheries policy	Development of and emphasis on increased food fish availability, increasing fishers' income, employment in fisheries, and sustainable management of fisheries.
	Marine Protected Areas	First marine parks designated for conservation and sustainable utilisation of marine resources.
	Customary communal fishing	Nearly abandoned, shift towards individualism.
	Traditional fishing techniques	Modified to cope with changing fisheries, rise in destructive fishing practices.
2000s	Economic importance	Increased production.
	Strong connection to fisheries	Slow uptake of other occupations other than fishing.
	Revised Fisheries Act	Enacted in 2003.

Source: Complied and developed from key informants and grey literature. Not exclusive to Mtwara district; for entire Tanzanian coast

Socio-ecological transformations in the local fisheries

The changes detected in this study were found to be directly related to the internal and external socio-political/economic and cultural circumstances in the villages. They were all influenced by the degree to which the village leadership stemmed from opposition political parties or that in control of the central government. In Nalingu, for example, the social-economic setting was highly fragmented, this situation being exacerbated by pressure from a few tycoons who, by virtue of informal power structures, had power over most villagers and village government leaders. Such power bases have therefore triggered a growing resistance to a number of government projects aimed at marine environment management in Nalingu, particularly the implementation of marine park activities.

Technological transformation in the local fisheries

The core fishing practises have remained unchanged in the study area for hundreds of years. Over the past 30 years, there has been an escalation in fishing effort to meet the growing local demand for fish and to generate a cash income. At the same time, local stocks have been depleted, threatening the future of the fishery (de la Torre-Castro, 2012). We found, however, that techniques such as the use of lights along the Msimbati channel to attract fish while night fishing have spread to nearby villages, especially Mngoji, Mkubiru, Sinde and Msangamkuu, which are located outside the study area. Fishing gear, especially ring-nets, which were not found in Mngoji, Mnete and Nalingu in the early 2000s, have become widespread in use, and many youths have joined fishing groups to access this gear from donors and NGOs.

Community members do not perceive there to be many technological innovations that could increase the efficiency of their fishing activities. Only a few individuals and fishing groups have modern tools such as goggles, cooler boxes or hand held global positioning systems (GPS). However, a modern tool that has been adopted by fishers is the use of mobile phones to find buyers, thus enhancing their interactive communication and marketing. In their opinion, this has helped them to improve their income, feel more secure at sea, and stay in contact with their families. Another example of a technical development in the fisheries is the conversion of purse seine nets (*kavogo*) into ring nets. The fishery continues to thrive locally with little intervention from outsiders, which hinders further investment in or development of their livelihood.

The majority of the respondents asserted that none of them had received formal training in fishing techniques offered by recognized institutions such as the Mbegani Fisheries Training Centre in Bagamoyo. However, some had received training to enhance the skills needed for sustainable fishing through donor-funded projects connected with the MBREMP.

Social structures and fisheries change

The interviews revealed that families rather than individuals formed the central units of society before the 1980s, when the fisheries exploitation was low. Emphasis was given to reciprocal rather than individual resource accumulation, and this was manifested in social events such as weddings and initiations (*unyago*) where food was generously distributed, including fish and other marine products. Individual and family fishing occurred on a daily basis, and villages sometimes organized groups that moved to other areas (Kilwa and Mafia, sometimes Mozambique) to fish for certain species. Resource management in villages fell under customary rules, though this was marred by the absence of individual usage rights. Perceived changes in the fisheries, particularly a decline in the fish catch and the loss of important species, placed pressure upon these social structures (Table 2). These changes in external and internal factors led to changes in the social structures, especially in the 1980s.

Table 2. Altered social structures following changes in the local fishery.

Indicator of change	Implications
Sacredness	Less sacred as an object of veneration than when fishery resources were abundant. Hence, the esteem and respect for nature has diminished; fisher family connectedness also appears to have diminished due to reduced 'togetherness' in the same livelihood.
Political organization versus kin groups	Power and primacy of political organisations have enacted a high degree of institutionalization and facilitated the extraction of resources.
Collective actions	Strong resistance to management ideas coupled with diverse economic interests limits revision of regulations on resource use.
Religious taboos	Professional cults in fishing instituted by religious belief e.g. avoiding going to the sea on certain days of the year, or women approaching the sea when menstruating, etc. are violated.
Indigenous technical knowledge systems	Intimate local knowledge on the status of resources, including rates of sustainable harvesting, etc., are less enforced today as of old and values have changed negatively.
Access by outsiders	Acceptance or non-acceptance of immigrants by clan or village leaders is no longer effective or followed.
Division of labour	Social organisation has drastically changed, fishing operations are profit-oriented with strong individualistic orientation.

Source: Focus group discussions and life history interviews

Barriers to cope with changes in the fisheries

Respondents' views and perceptions on their ability to cope with changes in the fisheries were mixed depending on their understanding of the resources and the vulnerability and adaptive capacity of the local community. Table 3 provides an overview of barriers they perceived to adaptation.

DISCUSSION

Interactions between human and fishery systems are dictated by a number of variables, these being cultural patterns, habits, customs and institutions, many of which have not yet been assessed for their relevancy and how they affect social structures (Perry *et al*., 2011). Based on our findings, the way fishers and fishing communities react to and interact with changes in fisheries resources is determined by perceived stressors, caused by a decline in the resource base. For example, in the late 1990s, respondents in our study noted that they were no longer catching large fish such as groupers (Serranidae), snappers (Lutjanidae), tuna (Scrombridae), sharks (Carcharhinidae) and emperors (Lethrinidae). The decline in catch undermined the traditional livelihoods of hundreds of coastal communities and their income.

These challenges to their livelihoods and food security forced them to mobilise support for each other and seek support from the government and donors to protect their marine environment. This was a good sign as self-organisation lead to the adoption of better harvesting techniques. These responses changed the social structure over the medium to long term. In other areas of the world where fishing communities adopted a high degree of self-organisation, they were able to minimise their vulnerability during adverse conditions such as inclement climatic conditions (Kalikoski *et al*., 2010). However, discussions with local communities during this study suggested that a number of opportunities that could have catalysed changes were not met by shifts in policy or practise for responsible management of the fisheries. For example, the national regulation for fisheries (de la Torre-Castro & Lindtröm, 2011) has not been able to handle ecological transformation in the fisheries on the Tanzanian coastline, including the Mtwara rural district.

Table 3. Overview of some of the barriers limiting communities to cope with changes in the fishery.

Barrier	Examples mentioned in interviews
Lack of systematic thinking	Altered perceptions as some individuals believe that the fisheries have not declined (fewer fish and more effort to catch).
Rapid changes in the local socio-economic system	Rapid changes in the local economy during the 1980s affected the social system that gives support to management institutions. Respect of traditional leaders and 'elders' has diminished.
Lack of innovative fishing practices	Most of the efficient fishing gears are not affordable, thus the majority still pursue traditional fishing.
Lack of financial capital	Low use of financial assets that are in line with fishing development.
Lack of human capital	Majority of individuals lack the necessary skills and knowledge to take up new enterprises besides fisheries.
Rapid increase in the population	Rapid growth in the population has disrupted traditional systems of access to fishing grounds. For example, in the past people were not allowed to fish in Msimbati channel during festival days or when mass spawning of fish occurred.
Governance of the fisheries	Weak law enforcement on selective gears, which has led to overharvesting of fisheries resources.
Cultural and normative behaviours	Cultural and normative institutions are strong enough, e.g. many still believe that fish sizes have not decreased as adults and large sizes of targeted species are still found in deep waters where access is difficult. Many still believe that fishing is their only option as a livelihood.
Relationships and shared histories	There is no common solution to issues as each group understands the problem in its own way and tries to resolve it according to their interests.
Markets	The structure of the market does not favour ordinary villagers; powerful traders are dominant. Fishers develop incentives to target large, valuable species at the expense of resource sustainability.

The realities of daily survival sometime weaken the social bonds that hold communities together. A lack of social prioritisation leads to conflicting interests, which ultimately result in trade-offs that threaten optimal management solutions. Our case was not different as we encountered disintegration in social structures, such as the loss of influence by elders and an erosion of communal fishing practices. It was obvious that fishers have changed the way they exploit and manage their resources based on economic benefits (Cinner *et al*., 2011). However, in the case of Mkubiru, Mnete and Nalingu, the local knowledge of the fishery has remained rather rudimentary and has not adapted to the changing conditions in the fisheries.

A lack of alternative livelihoods has contributed to disruptions in social ties. Family members caught fishing illegally are detained by law enforcers. Such families suffer from this separation and the wives have to take on the role of breadwinner when their husbands are jailed. As the population has increased, customary marine tenure practices have been abandoned. In this context, the population has developed alternative structures and values such as individual sharing and a cash-centred economy.

While fishers in the study area have remained rather passive in the wake of declining resources, those in other areas of the world such as Bangladesh (Kabir *et al*., 2011) and Nicaragua (Daw, 2008) have

taken advantage of new options, such as the development of new fisheries and distant markets. It is envisaged that the adoption of new activities could improve fishers' income, which in turn could nurture social structures such as family, kinships and marriage. Cinner *et al*., (2007) found that the influence of the socio-economic factors is variable; similar responses were envisaged and found in the communities we studied. For example, the dependency on marine resources was lowest in Mngoji and much higher in Mkubiru. Technological modernisation, on the other hand, was high in Msimbati where the population was greater. Communal structures have replaced systems of values and norms in Nalingu and Msimbati, while technological development has significantly changed fishing techniques in Mkubiru, Mnete and Msimbati. Accordingly, fisheries are developing differently in these villages.

The interplay between human and fishery systems seems to be different in sub-Saharan Africa when compared with stereotyped perceptions of fisheries in the developing world, the discrepancies being attributable to cultural differences. In South East Asia, for example, where fisheries are more industrialised than in Africa (Kim, 2010), fisheries management takes changes in social systems into consideration (Guillemot *et al*., 2009; Armitage and Marschke, 2013). This has not been the case in Tanzania.

Coastal artisanal fishers in Tanzania lack opportunities to pursue their self-development; they lack basic tools and equipment at prices they can afford. They have, however, gradually adopted developments and are transforming their activities (Thyresson *et al*., 2013), following changes in policy and strategy (Torell *et al*., 2004), for instance the establishment of marine protected areas and introduction of co-management in coastal areas (Tobey & Torell, 2006). Empirical evidence from similar studies suggests that people are adapting to progress under duress, and not because of external influences (Pomeroy, 2012).

A limitation in this study was the lack of deep-fishery ethnographic studies that could have validated the perceived and observed changes in fishing communities spanning over decades. An investigation by Jacob *et al*., (2013), for example, benefited from the triangulation of ethnographical assessments to reveal resilience and vulnerability in nine coastal communities, and how these changes affected their social structure.

Recent studies (e.g. Villasante, 2012) on the interaction between human and socio-ecological systems have brought radical changes to fisheries management, reducing its societal impacts. This work has revealed how rural artisanal fishing communities have weathered changes and pressures within the fishery sector. Our findings contribute to this body of knowledge, addressing the vague link between social structures and variably degraded common pool resources. This will help policy makers and planners in the fisheries and socio-economic development sectors to incorporate elements of transformation that are generally ignored in conventional management approaches to fisheries in poor countries.

This study thus provides a snapshot of socio-ecological interactions in the management of a complex interplay between fisheries and social structure. It reveals the strengths and weaknesses of incorporating social research in fisheries management. It further represents a contribution towards a more sophisticated stakeholder analysis, a gap identified in many studies linking human and marine ecosystems (Christie *et al*., 2007; Britton & Coulthard, 2013). In this respect, it is clear that research that targets sustainability in fisheries should also consider structural causes not tied to fishing per se. Social changes are not only linked to fisheries ecology but also other structural and macro-social parameters. Future research should focus on emerging players that intervene in the real-life process of transformation and development in the fisheries sector.

In conclusion, this study provides a contribution to our understanding of the interaction between fisheries and social structures in artisanal fishing communities and is informative on feasible management measures. It has identified and characterised changes in the fisheries and social structure in the coastal communities of Mtwara attributable to rapid development during the past five decades. It should be noted that, although the demographics may be similar in other parts of Tanzania, our study sites may not be typical of all Tanzanian coastal communities. The results are therefore not directly transferable to other settings, since different factors may be involved in every community. Thus, it would be important to assess the interplay of the relevant parameters in each community, taking into consideration its unique characteristics, especially the livelihood types, and the available human, social and cultural capital. The focus of this study was not on resilience (Ebbin, 2009; Béné *et al*., 2011) but it can contribute to the resilience perspective by providing a means of assessing the capacity of community to accommodate change. The wider implications of our findings point to a fine balance between traditional and modern structures, norms and practices to foster sustainability in local fisheries. The Mtwara coastal fishery is just one example of the way that small-scale fisheries have developed in recent years, and demonstrates how fisheries are intertwined with social structures. It is clear that successful fisheries management may be accomplished, provided that local practices are able to support it within their ecological, technological, institutional and cultural means. The fisheries considered in the study are in a state of transition and hence need to be reorganised under the present, more modern dispensation.

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