



[Click for updates](#)

Forum for Development Studies

Publication details, including instructions for authors and subscription information:

<http://www.tandfonline.com/loi/sfds20>

Social-ecological Changes, Livelihoods and Resilience Among Fishing Communities in Mafia Island Marine Park, Tanzania

Victoria H. Moshy^{ab}, Ian Bryceson^a & Rosemarie Mwaipopo^c

^a Department of International Environment and Development Studies, Norwegian University of Life Sciences (NMBU), Norway

^b Institute of Resource Assessment, University of Dar es Salaam, Dar es Salaam, Tanzania

^c Department of Sociology and Anthropology, University of Dar es Salaam, Dar es Salaam, Tanzania

Published online: 24 Jul 2015.

To cite this article: Victoria H. Moshy, Ian Bryceson & Rosemarie Mwaipopo (2015): Social-ecological Changes, Livelihoods and Resilience Among Fishing Communities in Mafia Island Marine Park, Tanzania, *Forum for Development Studies*, DOI: [10.1080/08039410.2015.1065906](https://doi.org/10.1080/08039410.2015.1065906)

To link to this article: <http://dx.doi.org/10.1080/08039410.2015.1065906>

PLEASE SCROLL DOWN FOR ARTICLE

Taylor & Francis makes every effort to ensure the accuracy of all the information (the "Content") contained in the publications on our platform. However, Taylor & Francis, our agents, and our licensors make no representations or warranties whatsoever as to the accuracy, completeness, or suitability for any purpose of the Content. Any opinions and views expressed in this publication are the opinions and views of the authors, and are not the views of or endorsed by Taylor & Francis. The accuracy of the Content should not be relied upon and should be independently verified with primary sources of information. Taylor and Francis shall not be liable for any losses, actions, claims, proceedings, demands, costs, expenses, damages, and other liabilities whatsoever or howsoever caused arising directly or indirectly in connection with, in relation to or arising out of the use of the Content.

This article may be used for research, teaching, and private study purposes. Any substantial or systematic reproduction, redistribution, reselling, loan, sub-licensing, systematic supply, or distribution in any form to anyone is expressly forbidden. Terms &

Social-ecological Changes, Livelihoods and Resilience Among Fishing Communities in Mafia Island Marine Park, Tanzania

Victoria H. Moshy^{a,b}, Ian Bryceson^a and Rosemarie Mwaipopo^c

^aDepartment of International Environment and Development Studies, Norwegian University of Life Sciences (NMBU), Norway; ^bInstitute of Resource Assessment, University of Dar es Salaam, Dar es Salaam, Tanzania; ^cDepartment of Sociology and Anthropology, University of Dar es Salaam, Dar es Salaam, Tanzania

Analysis of societal dimensions is increasingly receiving attention in social–ecological resilience research. This study investigates the impacts of neo-liberal marine conservation and economic policies, and environmental changes on the livelihoods of two fishing communities in Mafia Island Marine Park, Tanzania, and their response strategies towards attempting to maintain livelihood resilience. These communities are in similar geographical and administrative settings but differ in their proximity to Park headquarters, conformity to Park regulations and engagement in fish trade. Data were collected through in-depth interviews, focus group discussions, direct observation and questionnaire surveys. Interviewees from both villages reported increasing poverty in terms of reduced capacity to meet their basic needs, and decreases in numbers of meals per day, variety of foods and fish consumption, reduced access to resources, low productivity and prices of local produce. Women experienced raised household responsibilities for food security and meeting other household needs. Their main responses to these changes included loan seeking, reduction of expenditures, skipping meals, selling assets, collective fishing, livelihoods diversification, change of fishing techniques and gears, abandoning of fishing activity and outward migration. Their responses only contributed to survival without resolving the challenges. Paying attention to these societal experiences is therefore necessary, if resilience of social–ecological systems in a marine conservation area is to be maintained or enhanced.

Keywords: social–ecological systems; livelihoods; response strategies; resilience; marine protected areas; Tanzania

Introduction

Perturbations in marine social–ecological systems (SESs) have recently become a major concern of many conservationists in the world. These perturbations can be a result of two interdependent processes: introduction of policy interventions that control the access, use and trade of natural resources among resource-dependent communities; and the changing environmental conditions (Benjaminsen and Bryceson,

2012; Berkes and Folke, 1998; Marschke and Berkes, 2006; Marshall et al., 2009). For example, the introduction of global neo-liberal marine conservation and economic interventions have had mixed effects on local SESs (Mora and Sale, 2011; Kolding and Zwieten, 2011). In Marine Protected Areas (MPAs), it is pointed out that while these MPAs are often effective in conserving biodiversity, they tend to minimize extractive livelihood activities by controlling resource access among actors, and maximize market values of conservation areas in favour of maximizing tourism revenues (Brockington et al., 2008). Meanwhile, market-based production and economic interventions are reported to alter marine resource extraction patterns and provide unequal opportunities among actors (Coulson, 2013; Harvey, 2005). On the other hand, ecosystem processes such as species interactions may transform the environmental conditions, while anthropogenic processes such as livelihood activities, technology advancements and capitalist production exaggerate such environmental transformation (Brockington et al., 2008; Jones, 1992; Kolding and Zwieten, 2011). These interdependent social–ecological processes affect both ecological and social components of marine SESs.

Increased trade and large-scale investment in marine fisheries under the neo-liberal capitalist economy regime fails to provide equal opportunities among actors, and has both ecological and social costs (Berkes, 2003; Harvey, 2005). While such investments are profitable among investors, they reduce fishery productivity, economic gains and fish supply for improved food security among resource-dependent communities, who are often the least powerful actors (Harvey, 2005; Jennings and Polunin, 1996; Perry et al., 2010). Meanwhile, marine conservation efforts to restore declining marine resources may contribute to both increased fish catches and food insecurity in MPAs (Baker, 2013; Benjaminsen and Bryceson, 2012; Mascia et al., 2010). The costs of free market and conservation benefits are thus also distributed unequally between social and ecological components, and among actors with unequal power relationships (Bryant and Bailey, 1997; Christensen and Krogman, 2012).

While conceptualization of ecological components is relatively well established in the marine SESs perspective and conservation pursuits, it is not so for social components (Coulthard, 2012; Fabinyi et al., 2014). The main reason for this is that conceptualization of social components in marine SESs conservation has lacked in-depth analysis of the immediate needs of resource-dependent communities and their well-being status. This article is intended to address this weakness by focusing the analysis of the Mafia Island Marine Park (MIMP) social conditions, with emphasis being placed on their daily experiences and pursuits for income, food, resilient livelihoods and well-being. The goal is to contribute to current efforts of strengthening social perspectives of SESs in resilience thinking by adoption of social–ecological resilience (SER) approaches¹ in the context of a developing country. These social aspects can influence

¹Adoption of social-ecological resilience (SER) approaches is increasingly recommended for its potentials to consider both social and ecological components of SESs and minimize adverse

human–environment interactions and responses, and may contribute to providing social–ecological feedback to managing bodies, and thus provide a better understanding of social mechanisms in relation to resilience.

Concepts and analytical framework

This study combines SER and political ecology approaches with some concepts of livelihoods and well-being to investigate implications of key changes experienced in two villages within MIMP and key conditions that strengthen or weaken SER. The concept of SER refers to the ability of SESs to respond to perturbations while retaining their function (Folke et al., 2003; Walker et al., 2004). Thus it guides our analysis of how fishing communities deal with social–ecological changes to maintain their income, food security and living conditions by embracing social learning, nurturing diversity, combining various knowledge types and self-organizing to build SER (Adger, 2000; Folke et al., 2003). While both ecological resilience and social resilience are crucial in obtaining SER (Coulthard, 2012), we attend to the growing need to understand the social aspects of SER.

The applicability of resilience thinking to understand social systems is still debatable (Davidson, 2010). This is partly due to lack of incorporation of social theories in its accounts (Beymer-Farris et al., 2012; Coulthard, 2012) and inherent differences in behaviour, processes and structures between ecological and social systems (Adger, 2000). Resilience also tends to overlook the role of human agency, social stratification, social factors that maintain undesirable states and questions of power relations among actors (Brown, 2013; Fabinyi et al., 2014). Thus a political ecology approach is deemed useful in analysing how neo-liberal conservation, capitalist relations and political economic drivers can result in poverty at the local scale (Blaikie and Brookfield, 1987). In this article, the political-ecological questions are explored in terms of capitalist relations of production linked to non-class factors such as the state-sponsored conservation of the fishery in the MIMP (Bryant and Bailey, 1997). As a critique of the ‘environmental crisis’ narratives that have informed public policy in marine conservation in the MIMP, the article attempts to integrate local concerns and evidence of biophysical change with political economic causes by collecting new place-based data as suggested by Blaikie (1985).

Our understanding of livelihoods follows Chambers and Conway (1992), Ellis (2000) and Allison and Ellis (2001) who broadly define livelihood in terms of requirements for, and processes of gaining a living, satisfying needs and improving standards of living. Meanwhile, our analysis of livelihoods in the context of rural marine SESs is

social-ecological effects that individuals face on a daily basis in their struggle to survive (Berkes et al., 2003; Christensen and Krogman, 2012). However, due to existing power relationships in SES perspectives, ecological components and institutional aspects of human–environment relations (Berkes and Folke, 1998) are privileged in social-ecological studies whilst social components in terms of diversity of human interests, experiences, complex social processes across scale, and the role power are marginalized (Coulthard, 2012; Fabinyi et al., 2014).

informed by Berkes and Seixas (2005), Marschke and Berkes (2006), Bunce et al. (2010); Benjaminsen and Bryceson (2012); and Beymer-Farris et al. (2012) who show how livelihoods of fishing communities usually encounter uncertainties related to resource fluctuations, foreign investments impacts, and restrictive conservation. Local views of 'good life' are included as a supplement for well-being and resilience.

Context and methods

The MIMP, covering an area of 822 km², is located within Mafia Island, an archipelago forming Mafia District and located about 120 km southeast of Dar es Salaam. The Island has the richest marine biodiversity in the western Indian Ocean and is a globally recognized area for marine biodiversity and conservation (Benjaminsen and Bryceson, 2012). The island has an average annual rainfall of 2000 mm and receives short rains between October and December and long rains from March to May. Air temperatures range from 20°C to 32°C. The Northeast Monsoon occurs from December to April and Southeast Monsoon between June and October. The soils are mainly sandy loam while coral rags dominate in some areas with little soil cover (Bryceson et al., 2006). These biophysical and climatic characteristics have great influence on villagers' choice and focus of livelihood activities over time, but also make villagers vulnerable to economic shocks and stresses. For example, strong winds during the Southerly Monsoon make fishers vulnerable to safety and income shocks.

Livelihoods are also influenced by various political economic factors. Since colonial times, farming was important in Mafia Island, whereas fishing was mainly practised in Jibondo and Bwejuu islands (Caplan, 2002). Following the global slump in demand for copra, increased demand for sea products and local competition from cheap imported cooking oil under neo-liberal economy during 1980s, more villagers were drawn into fishing (Caplan, 2002; 2007). By 1989, the foreign-owned sea products processing factory, Hellas Company Ltd, was established in the Island at Kilindoni. By 2002, Hellas was sold to TANPESCA Ltd, the first and largest marine finfish processing factory in Tanzania, which is recently blamed for offering low prices to fishers while increasing fishing pressure (Bryceson et al., 2006; Caplan, 2002). Marine finfish export has been illegal until 2002, when Tanzania made a trial change in fisheries policy to allow export of finfish from her coastal waters (Bryceson et al., 2006). Meanwhile, the establishment of MIMP in 1995 as a response to dynamite fishing and global biodiversity conservation demands initially gained local support because its initiatives halted dynamite fishing and widened livelihood options (Bryceson et al., 2006; Walley, 2004). However, since 2000s increasing protectionism, restricting fishing gears and access to rich fishing grounds also downplayed societal needs, and limited the extent of local participation, thereby bringing resistance to MIMP operations among Park residents (Benjaminsen and Bryceson, 2012; Mwaipopo, 2008; Walley, 2004).

The Park residents reside in 13 villages, 4 being wholly within the Park boundary. The 13 villages are often grouped as Park villages without much consideration of their contextual differences. This study focuses on villages that are totally located within the Park. Chole and Jibondo villages were selected because they lie within the MIMP but had different contextual characteristics. The villages had populations of 1021 and 1707, respectively (URT, 2011). Chole was closer to the MIMP headquarters, had a foreign-owned tourist hotel, had the highest poverty level and regularly conformed to MIMP regulations (Bryceson et al., 2006; Walley, 2004), whereas Jibondo was further from the MIMP centre, demonstrated non-conformity to MIMP regulations and was a typical fishing village with fish traders and factory agents (Bryceson et al., 2006; Caplan, 2002; McClanahan et al., 2009). Thus, these two villages were chosen to facilitate a deepened understanding of perturbations and response strategies among the people who are often grouped under the label ‘Park residents’.

Data used in this article were collected for eight months, between August 2009 and March 2011 using both qualitative and quantitative techniques (Bryman, 2004). For qualitative methods, wealth ranking was conducted to gain an understanding of how various individuals were differentially affected by or responded to social–ecological changes. Three wealth categories (rich, poor and poorest) were identified using villager-identified wealth status indicators (number and quality of assets and meals per day, and ability to work and handling emergencies). Seasonal calendars were used to identify livelihood activities throughout the year, and 48 key informant interviews, which included officials at MIMP and Mafia district authorities, were used to obtain data at household and institutional levels. Other methods used included 13 focus group discussions (FGDs) and collection of life histories of individual fishers. These methods facilitated contextual understanding of the ways in which people interpreted change in their lives and their responses to stress as a result of social–ecological changes. Direct observations were made on catch landing sites, farming plots, food consumption and general living conditions and processes to further understand reported issues.

Structured open-ended questionnaires administered to 37 and 66 heads of households randomly selected from wealth categories in Chole and Jibondo, respectively, complemented qualitative data and provided quantitative indications of changes and responses. To obtain information related to income, respondents were asked to estimate their average income from their activities, from other household members and remittances. We wanted them to specifically show income and expenditure fluctuations depending on types of livelihood activities and frequency of payments. To obtain food-related information, respondents were asked to give variations in the number of meals per day and diet diversity between 1980s/1990 and 2010/2011 periods. They also estimated the number of days without consuming protein foods (fish, pulse, eggs, chicken, beef and milk), and explained why their income, food trends and livelihoods were changing and how they were responding to these changes, before providing their views of ‘good life’.

The analysis of data was conducted through coding of interviews, FGDs transcriptions and drawing meanings using thematic analysis. Quantitative data were also coded and analysed to reveal possible trends in percentages. Since it was noticed from both qualitative and quantitative data that income levels and trends were largely influenced by four compounding factors, that is, seasonality, ocean tides, shocks from management interventions and price fluctuations, it became clear that income estimates could obscure their reality of living conditions, since they fluctuated too often. Hence, as also suggested in Narayan and Pritchett (1999), we decided to use daily expenditure² estimates to reflect living conditions because expenditures were more stable over time than income.

Results and discussion

People's livelihood situations were observed to have resulted from cumulative impacts and interlinked processes related to social–ecological changes and their responses strategies. As such, people's experiences of the emerging trends of livelihood activities, economic conditions and food security are discussed in relation to responses to changes in strategies of resource management and marketing, and environmental conditions over time.

The changing livelihoods situations

The socio-demographic conditions of respondents influenced their ability to earn and maintain their living, and provided a broad picture of their living conditions. Respondents in Chole were aged between 30 and 75 years (mean age 49) and in Jibondo between 25 and 90 years (mean age 53). About 76per cent of respondents in Chole had primary education, and only 1per cent had diploma. In Jibondo, 65per cent had primary education, and only 1per cent had secondary education. Average household size was 5 persons in both sites, but household size in Jibondo ranged from 1 to 15 and from 1 to 7 in Chole. About 5per cent of households in both sites were classified as rich, while 10per cent in Chole and 5 per cent in Jibondo were grouped as poorest. Respondents in Chole had poorer housing conditions than respondents in Jibondo. In Chole, 60 per cent of their houses had mud floor, 81 per cent had mud-pole walls, only 11 per cent had metal roofing and 35 per cent had banana leaves fence because palm leaves were unaffordable. In Jibondo 48 per cent had mud floor, only 27 per cent had mud-pole walls and about 26 had metal roofing.

Changes in livelihood activities

Livelihood activities have been changing over time. Until the late 1990s, a majority of men in Chole and Jibondo had been mainly engaging in fishing, and subsistence crop production, together with women. Rope-making dominated among women in Chole,

²All money values are in USD based on the February, 2011 exchange rate of 1 USD to 1393 TShs.

while in Jibondo octopus-fishing was predominant. During this study, however, most men in Jibondo engaged in fishing and some elderly men joined the women in seaweed culture. In Chole, farming was predominant for both men and women, and a few people were employed at Chole Mjini tourist hotel. Rope-making was still practised by women. Thus, both temporal and gender dimensions to livelihoods are important for understanding livelihoods dynamics.

Diversification of livelihood activities was a key feature among households. Respondents reported other household members to be engaged in seaweed culture (78 per cent) and octopus-fishing (67 per cent) in Jibondo, and farming (57 per cent) and rope-making (51 per cent) in Chole. Livestock keeping, business, petty trade, thatch weaving, handicrafts, casual labour, house construction and vessel building were practised at both sites. The dwindling activities were farming at Jibondo, whereas at Chole, fishing and seaweed culture were in decline. About 27 per cent and 68 per cent of respondents in Chole and Jibondo, respectively, owned seaweed culture ropes. The average number of ropes owned by each respondent was 13 ropes, ranging from 15 to 22, which was lower than 64 ropes, ranging from 10 to 200 at Jibondo. Diversifications within the fishery, and of fishing methods was common in Jibondo but made them temporarily less resilient to maintaining their needs and fishing livelihoods when shocked by sudden actions. For example, the fishing gear confiscation by the MIMP in 2010 caused extreme hardship conditions at Jibondo (Benjaminsen and Bryceson, 2012), but was rather a stress in Chole because people's dependence on fishing was declining. This variation supports Berkes and Folke (1998) argument that a similar event can result to shock into one area and stress into another, depending on their contextual variations. Overall, by diversifying, small cumulative gains from each activity contributed towards maintaining a living, but their general economic situations remain undesired.

Economic situations

Low economic status and mismatch between income and expenditure were reported as key concerns among interviewees because their income did not fulfil household needs. Traditionally, men had the role of earning income and satisfying household needs. However, following their engagement in seaweed culture, middle-aged women at Jibondo were found to be financially stronger than some of the men and the interviewed female household heads revealed that they met their basic needs without assistance. This undermined women's capacity to carry out their role in children's upbringing and well-being, although it may also suggest an important role played by women in sustaining life at Jibondo (Hauzer et al., 2013; Moshy et al., 2013). However, women were cautious to reveal their actual earnings to their spouses, in trying to avoid being made to shoulder household maintenance or in fear of men using their income for personal interests such as paying bride price for another wife. Nonetheless, owing to the traditional gender set-up, men were mostly affected by the dwindling income because of their

declining capabilities to cover household expenses without financial contributions from women or other individuals.

Household expenditure (Table 1) ranged between US\$ 0.7 and 10.7 per day. Respondents living above US\$ 5 a day were 16 per cent and those living below US\$ 2 per day were 14 per cent. During this study, 70 per cent of respondents at Chole and 56 per cent at Jibondo had debts (Table 1), mainly incurred for meeting basic food needs in Chole (88 per cent) and Jibondo (84 per cent); to acquire fishing equipment in Chole (19 per cent) and education in Jibondo (19 per cent). Emergencies such as sickness, or business needs, land purchase, construction and costs for ceremonies also led to debt. Only 4 per cent at Chole and 11 per cent at Jibondo had debts above US\$ 215. Debts were higher in Jibondo than Chole because women covered non-food household expenditure but households also covered expenses for education, replacing confiscated fishing equipments, and food. In Chole, secondary education expenses were covered by Chole Mjini hotel, confiscation incidences were few and most food was locally produced. However, expenses for meeting household needs for fish protein were higher in Chole because fishing had decreased. Although taking debts is common among fishing households, the extent of debts in study areas is higher than would expected. This may concur with the argument that debts reflect desperate coping strategies which usually worsens household conditions (Marschke and Berkes, 2006). Although as Béné (2009) notes, it is necessary not to generalize or assume that fishing communities are inevitably poor; nevertheless, the interviewees of this study have in fact showed increasing both economic vulnerability and impoverishment. Nonetheless, 51 per cent of respondents at Chole and 45 per cent at Jibondo had money savings (Table 1), reflecting some preparedness for uncertainty. Respondents with savings above US\$ 215 were 14 per cent at Chole and 11 per cent at Jibondo. Low savings and convenience considerations meant that most respondents keep their savings at home or in shops.

The small variations in daily expenditure and large variations in the money debts and savings across the wealth categories reflect the likelihood of social–ecological relations to produce unequal outcomes (Beymer-Farris et al., 2012), even among local resource users, and may suggest that not everyone was living in poverty. However, these money-related indicators did not directly appear in villagers' poverty indicators as the indicators related to assets and ability to work did. Although poverty is evident in our study, we also concur with others in questioning the tendency of attributing monetary terms to poor living conditions without considering a wide range of social, cultural and institutional factors (Béné, 2009; Onyango and Jentoft, 2013).

Response strategies to income shortage varied (Table 2). Fund-raising fishing was a unique strategy that assisted most poor villagers at Jibondo to meet education and housing constructions expenses. Thus, outsiders hardly observed poverty gaps among villagers, and judged villagers as high-income earners based on (communally achieved) better housing conditions compared to other villages. Meanwhile, Chole

	Chole Average (range)			Jibondo Average (range)		
	Rich	Poor	Poorest	Rich	Poor	Poorest
Daily expenditure	4.3 (3.5–5)	3.3 (1.4–7.1)	2.4 (1.4–4.3)	4.2 (2.1–7.1)	3.8 (1.7–10.7)	2.5 (0.7–3.5)
Debts	75.5 (10.7–143.8)	59.4 (2.1–228)	13.2 (7.1–215.8)	597.1 (86.3–1438.8)	63.2 (0.3–215.8)	16.2 (2.1–143.8)
Savings	264.3 (21.5–1079.1)	200 (3.5–489.2)	57.5 (7.1–107.9)	437.4 (35.9–1151)	116.4 (3.5–431.6)	41.9 (10.7–100.7)

Table 1: Estimates of expenditure, debts and savings by area of residence and wealth category (in USD).

residents lacked collective actions to meet their needs, partly because their livelihood activities were mostly performed individually, and had access to full educational scholarships. As Coulthard (2012) asserts, responses for managing change do not automatically lead to well-being improvement. Overall, the household responses were effective for short-term mitigation rather than ending existing challenges altogether.

Trends in food security

Daily struggles to meet food needs were most common, particularly at Jibondo. One interviewee explained that he was fasting throughout the year as if he was in Ramadan because he could only afford one meal a day (elderly man in Jibondo, 82 years old, 2009). Most respondents could afford three meals a day three decades ago, but they reported that they had now lost such ability (Table 2). Respondents who were uncertain about having three meals a day increased from 16 per cent to 59 per cent at Jibondo and 16 per cent to 35 per cent at Chole during the last 30 years. Overall, these changes were attributed to declining income levels, Park operations, drought and decline in food production in Jibondo.

Changes in the varieties of food consumed were more reported at Jibondo (Table 2). Maize-meal, rice and occasionally beans were mostly consumed in both sites. However, the majority at Jibondo hardly had the varieties they consumed in the past, including sorghum, cassava, potatoes, dolichos beans, cowpeas, pigeon peas, bambara groundnuts, pumpkins, cucumbers and pawpaws. In Chole, bananas, cassava, sweet potatoes and yams were still produced and consumed. The changes were attributed to drought (53 per cent) and decreased income (18 per cent). Other reasons included sickness, persistence of coconut tree disease and the effects of coconut tree roots in hindering growth of root crops. In Jibondo, causes were decline of farming (76 per cent), livestock free-grazing (46 per cent) and soil erosion (24 per cent). Other reasons included increased focus in fishing, decreased income, seasonality, old-age and unavailability of food varieties in local shops. Most of these reasons for decreasing food varieties were in fact originating from various response strategies, which are summarised in Tables 2 and 4; thus reflects the tendency of responses to either build or erode resilience (Marschke and Berkes, 2006) to food security.

Although transformation into new activities at lower scale intends to maintain resilience at higher scale of a particular SES (Folke et al., 2010), resorting to livestock keeping appears to build resilience among 'wealthier' individuals, but had worsened the community's resilience in maintaining food supply. This reflects the importance of analysing resilience-building responses at various levels (Magis, 2010; Merschke and Berkes, 2006). Institutional diversity as a key strategy for building SER (Folke et al., 2003; Jones et al., 2013) was relatively impractical in dealing with food insecurity because there was inadequate support from existing managing institutions across scales. This reflects the necessary need for efficient inter-sectoral management approaches in solving food insecurity (Foale et al., 2013).

Key Indicators	No. of respondents in percentages	
	Chole	Jibondo
Number of meals per day during (1980s/1990s), (2010/2011)		
One	(0), (0)	(0), (3)
One to two	(0), (0)	(0), (2)
Two	(11), (13)	(8), (39)
Two to three	(5), (22)	(8), (15)
Three	(81), (65)	(83), (41)
Four	(3), (0)	(1), (0)
Respondents experiencing changes in meal diversity	51	96
Period that respondents stayed without fish protein		
Missed fish during 'neap tide' (about 1 to 5 days	*	88
Missed fish in the long-term basis (about 7 to 60 days or more	43	*
Respondents without food reserves at the time of interview	54	65
Respondents experiencing Income-expenditure mismatch	94	97
Key response strategies to income and food shortages		
Obtained credit from shops, traders and individuals	86	70
Used women's income on non-food household expenses	67	59
Collaborated with household members to meet non-food household needs	73	86
Periodic remittances covered household food expenditures	32	50
Reduced expenditure	19	17
Harvested crops before time	14	—
Sought for assistance	—	30
Worked harder	—	11
Sold household assets	*	*
Produced own thatch and fishing gear	*	*
Reduced food portions	*	*
Resorted to casual labour	*	—
Rented out small vessels temporarily	*	—
Produced own food	*	—
Fished sardines or juvenile fish in shallow inshore waters for consumption	*	—
Ate plain food (rice, bananas or maize-meal) or with cassava leaves	*	—
Ensuring food was stocked	*	—
Used the tips obtained from tourists	*	—
Skipped meals	—	*
Ate at relatives' households	—	*
Ate dried fish, also boiled raw pawpaw	—	*
Fishers provided fish to elders and non-fishing households	—	*
Sold reserved water	—	*
Took children to relatives within village and Mafia Island	—	*

(Continued)

Table 2: (Continued).

Key Indicators	No. of respondents in percentages	
	Chole	Jibondo
Paid school expenses in instalments	—	*
Obtained collective support through fund-raising fishing, a tradition whereby pull-net fishers organized fishing trips on request and gave the resulting income to a needy individual	—	*

Table 2: Food and income trends, shortages and response strategies at Chole and Jibondo.

—Response strategy not mentioned at particular study site.

*Situation/ strategy less mentioned but exists/ practiced.

Interviewees also consumed less fish and some consumed small-sized fish or stayed for long periods without fish protein (Table 2). They expressed this experience as follows:

We used to cook lots of fish . . . say three were cooked in stew, four were fried and eaten as bites, and three others were grilled with spiced coconut sauce. We ate more fish than any other food. Now we only cook two small fish in stew to cover-up inadequacies. Fish grilled with coconut sauce is never available and most people don't even know it now. (Interview with a 73 years old fisher in Jibondo, 2010)

In the past when you went to any household you would find yesterday's fish in the pot. Today, go to any house and you won't find fish. (Interview with a 52 years old former fisher in Jibondo, 2010)

Meanwhile, most respondents had less ability to consume other protein-rich foods (Table 3). Although most respondents (63 per cent) kept chickens, its consumption

Period without other protein	Percentages of respondents having other protein foods									
	Pulse		Eggs		Chicken		Beef		Milk	
	C	J	C	J	C	J	C	J	C	J
One to six days	21	23	12	11	—	—	—	2	14	11
One to three weeks	49	37	21	24	21	23	14	2	8	20
One to six months	25	35	43	20	52	36	51	34	40	20
One to three years	—	1	16	31	16	32	19	46	17	16
Always (cannot afford)	—	1	8	11	8	6	11	14	16	32
Allergic/sickness	5	3	—	3	3	3	5	2	5	1

Table 3: Rates of consuming other sources of protein in the two sites.

Note: C, Chole and J, Jibondo.

was low because chicken were used in traditional rituals, and were assets that were sold during times of crisis. The quality of food had also deteriorated, and vegetables were consumed less frequently. Amounts of food per meals were reported to have decreased and most respondents had no food stocks (Table 2) because they afforded purchasing only enough for immediate consumption.

While skipping meals as a coping strategy has been observed elsewhere (Bunce et al., 2010), the food trends and related responses (such as merely having carbohydrate meals) might suggest increasingly desperate conditions to obtain daily sustenance and can have long-term implications for people's health and resilience. The suggestion by Foale et al. (2013) on including food security programmes in conservation actions in MPAs holds. This is because majority of villagers were incapable of meeting the requirements for food security, and Moshy et al. (2013) reported their children to have poor nutritional status that can have serious implications for their well-being and SER.

Aspects of household food insecurity in terms of quality, quantity, preferences, affordability and availability (FAO, 2010) were vivid. Park operations contributed to food insecurity both directly and indirectly by causing decreased fishing, fish catches, fish consumption, and income for purchasing food, including fish. This is contrary to findings by Darling (2014), showing benefits of MPAs in Kenya neither increase nor decrease food security and by Mascia et al. (2010), showing increased food security within 20 MPAs in 11 countries. The use of catch (production) as a proxy for food security in the latter may partly explain this variation. The variation also highlights the need to consider the access and consumption aspects of food security (Foale et al., 2013) because total catch within MIMP increased from 1394 tonnes in 2002 to 3854 tonnes in 2009 (URT, 2011), and overall catch in Jibondo is reported to increase (Moshy et al., 2012). However, fishers sold most of their catches to buy food. Food security in most island communities is a critical issue due to great reliance on fish for dietary protein and food security, increased fish demands and integrations to global economy, and increasing tensions from conservation (Foale et al., 2013; Hardy et al., 2013; Hauzer et al. 2013).

Changes in conservation strategies

The establishment of the MIMP originally heralded closer collaboration between officials and local communities to halt dynamite fishing. In 2000, the MIMP's General Management Plan (GMP) was put in place and park operations began with emphasis placed on biodiversity conservation and sustainable utilization of natural resources (URT, 2000). Access to fishery resources were regulated through user certification, licensing, limits of fishing gears and restricted fishing areas. MIMP also introduced environmental education and training in entrepreneurship skills; promoted research; and sustainable fishing practices through gear exchange program. Alternative livelihood activities such as seaweed culture and beekeeping; provision of school fees

support for secondary education students; improving health and water facilities; and loans for economic development projects became part of the social development package.

MIMP interventions did not, however, provide equal opportunities to all Park residents. For example, a one-week seaweed culture training course in 1999 involved only 20 Jibondo residents (MIMP official written response, 2011). However, though sharing knowledge, more than 561 women and 12 elderly men were practising seaweed culture during this study. The process of selecting beneficiaries of various projects reflected favouritism rather than equality (Mwaipopo, 2008; Walley, 2004). For example, the gear exchange programme targeted beach-seine fishers, and left out the line and hook fishers.

Data from the interviews showed that MIMP rigidly pursued its operations regardless of their impacts on livelihoods, and people's responses did not resolve their livelihood challenges. The closure of rich fishing grounds reduced number of fishing grounds. Meanwhile, restrictions on fishing gear were problematic. Pull-nets, which were considered to be effective in relative deep water, were prohibited. Prescribed gears such as long lines were expensive, set-nets had bigger mesh size and had to be set in shallow water where fish had decreased, and gill-nets material spoiled catches and had to be set in deep water where strong currents swept them away. Such operations contributed to decreased fish availability and income. In response to Park's operations, most fishers in Chole abandoned fishing, engaged in farming to produce their own food, rented out boats and engines although the payments were low and unreliable. They also fished by sail vessels or on foot, migrated elsewhere and requested for major changes in Park strategies during GMP review in 2011.

Interviewees in Chole estimated that about 50 per cent of fishers abandoned fishing and villagers no longer considered themselves as a fishing community, implying that fishers in Chole were the most affected, as one fisher explained:

MIMP gave us a two weeks training on alternative fishing using gillnets. We went to Kilwa, Somanga and Songosongo for practice but we failed [to obtain catch] and they [MIMP officials] saw that we failed. They tried all their professional fishing and we used our experience but we did not obtain catch with this set-net fishing. People fought to get the nets which were provided, but when they came and set them, they only found mangrove leaves and dry wood. We tell them [MIMP officials] the nets don't fish but they don't want to listen. (Interview with a 33 years old fisher in Chole, 2010)

In Jibondo, fishers resisted Park operations and voted to reject MIMP in 2004 on the grounds that it brought a crisis in their lives. They persisted in pull-net fishing and sun-dried gill-net spoiled catch to reduce loss. They also invested in children's education to widen their future livelihood options, and voted again to reject the MIMP during GMP review. The repeated decision to reject the Park demonstrated that they

sustained their social memory, collectiveness and constant struggle to survive as noted elsewhere by Folke et al., (2003); Magis (2010); Brown and Westaway (2011). One FGD discussant puts it this way:

When they [MIMP officials] stopped us we decided that it was better to die from gun shots instead of letting families die of hunger. You see us like this, but we are as if in a war like the Somalis. We don't know what will come next. We struggle with the beatings so that our children can eat. (Discussant, a 45 years old fisher in Jibondo, 2009)

It was further shown that dialogue between MIMP officials and local people decreased, and violent approaches to enforcement of regulations became applied. Patrols were sometimes armed and involved beatings, harassment, exacting stiff penalties and confiscation of vessels, engines, gear and catches. Fishers were concerned that they could not escape the vicious beatings even if they owned valid fishing licenses. They recalled being physically attacked four times since violent enforcement approaches began in 2006. Although they hid or tried to resist the attacks, they were overpowered and were harassed and whipped. Meanwhile, the confiscation strategy caused repeated losses of fishing equipment and decreased safety at sea because crew members paddled with their sandals for propulsion to return to the coast when there were no sails at times of engine confiscation. Confiscations also decreased fish catches, income and food security. In response to confiscations, fishers opted into octopus fishery and used other gears while arranging loans from fish traders to buy new equipment. Their efforts to replace confiscated equipment suggest that confiscation operations may not necessarily be effective in conservation because the loans compel fishers to increase fishing operations to afford their repayments (Allison and Ellis, 2001; Crona et al., 2010). In fact, it increases ties between fishers and fish traders (Crona et al., 2010), thereby empowering traders to control the fishery and thus further worsening the economic status of fishers and contributing to decreasing presence of fish and octopus in the ocean. Their investments on children's education implies that people had not only come to expect the worst from MIMP in the future, but they had also come to realize their capacity to create opportunities for renewal as discussed elsewhere by Folke et al. (2003). Nonetheless, interviewees emphasized that although in principle they valued conservation initiatives, they condemned the manner in which such a valuable idea was being implemented. They were particularly concerned with the shift from genuine collaborative practices with villagers to rhetorical, authoritarian and violent operations during the past decade (Benjaminsen and Bryceson, 2012). On the positive side, the shift promoted unity among the villagers against an increasingly authoritarian MIMP.

The variations in responses between study sites reflect the heterogeneity in people's actions in responding to changes, as noted elsewhere by Leslie and McCabe (2013). Meanwhile, the adverse MIMP-related effects exemplify the likelihood of social-ecological processes to produce unequal outcomes in SESs that constitute competing resource users (Beymer-Farris et al., 2012). This is because the ecological part of

MIMP SESs is in a relatively good condition (Baker, 2013; URT, 2011), which is desired by conservationists, government and tourism operators, while the social part experience poor and undesired conditions (Benjaminsen and Bryceson, 2012; Moshy et al., 2013; Mwaipopo, 2008; Walley, 2004). Although park authorities are urged to ensure that the needs of resource-dependent communities are met (Marshall et al. 2009), the real challenges of day-to-day life within the MIMP have resulted in increased hardship and poverty. This affirms the argument that transformation into a fundamentally different system that improve future conditions will only occur when actors agree that the current system is dysfunctional (Beymer-Farris et al., 2012; Walker et al., 2004).

Changes in marketing strategies

The neo-liberal economic reforms and capitalist market economy from the 1990s were also seen to have added further livelihood challenges that were difficult to resolve. The shift into selling fresh catches was beneficial because fishers received income immediately after fishing trips. The shift attracted increase in the number of fishers and time allocation for fishing because crop production decreased substantially. Fishers began fishing during neap tides and rainy season, formerly left for farming. However, they were not progressing because they lost abilities to receive bulky earnings (from sun-dried catches), save money, stock catches for household consumption and afford food purchase. They were also underpaid, owing to their low bargaining power. For years, Dar es Salaam traders maintained their price at about US\$ 2.1 per basket of around 50 medium-sized fish. In 2006, Jibondo village government replaced external traders with resident traders to improve money circulation within the village, and credit provision during hard times. This reflects the possibility of grassroot institutions to self-organize for enhancing their social security. The traders bought most of the fish catch and guaranteed social security among the villagers because they owned fishing vessel and gears, operated small shops and were present in Jibondo most of their time to provide support. Furthermore, the replacement slightly improved prices for the catches. By 2011 the price of a bucket of about 25 fish had risen to around US\$ 5.7 from resident traders and US\$ 7.8 from independent buyers. The price of each kilogram of fish was US\$ 1.1 from resident traders or US\$ 0.9 from factory agents while each kilogram of octopus fetched about US\$ 1.1 from factory agents and resident traders or US\$ 0.9 direct from the factory. Fishers argued that had they been determining prices by themselves, they would suggest about 2.1–3.5 USD per kilogram of fish or octopus, given their actual costs of living and risks encountered while fishing. Thus fishers had to fish more to afford basic living costs.

On the contrary, the factory agents facilitated fishing vessels to women to obtain most octopus catches at a low price. The agents were also blamed for denying fishers credits during hardships and setting poor market relations. In Jibondo, villagers argued that the factory had not improved the market conditions as envisaged, as evidenced by one discussant:

Market requires knowledge about buying and selling prices . . . Me as a fisher, I don't know market issues. The trader is the one knowing market issues, and is the one benefiting . . . Even when a fisher decides to sell catch direct to the factory, he will then get a lower price than those selling to agents. (Interview with a 45 years old Fisher in Jibondo, 2009)

Respondents at Jibondo also explained that the factory constrained them because it offered low prices over the years (70 per cent); delayed payments (35 per cent); did not re-invest into village development (22 per cent) and contributed to degradation of the octopus fishery (15 per cent). Other constraints included inability to afford quality fish and octopus for consumption, deprivation of credits during hardships, dwindling of dried fish trade, mistreatment of octopus fishers by overloading them in the fishing boats and tampering with the weighing scales by agents. The factory was also blamed for drawing more men into octopus fishery, which decreased women's catches and income substantially. Thus, middle-aged women reduced the time spent in octopus gleaning to three days per springtide and turned to seaweed culture, which earned them bulky payments. Elderly women resorted to farming, pottery, hand-crafting and babysitting. Interviewees also blamed seaweed companies for offering low prices (US\$ 0.3 per kilogram against the expected US\$ 1.4), and tourist investors for excluding them from tourism operations.

Overall, people experienced low prices for most products produced, which also trapped them in poverty. The district's poor economic status, marginalized position within the country and difficult transportation logistics further compounded price challenges. Nonetheless, low prices reflect inadequate capabilities of people to influence the market to operate on their favour. At the same time, village government intervention have not been profitable ventures. The marketing issues may confirm inadequate capacity of resilience thinking to make radical changes, thereby maintaining existing states (Cretney and Bond, 2014), even when such states are undesirable. Capitalist economy has tendencies of shaping uneven ability of communities to respond to changes such that by expecting people to respond to its effect, a resilience approach demonstrates inability to confront global capitalism (Mackinnon and Derickson, 2013). In this case, diversifying institutions (Folke et al., 2003; Merschke and Berkes, 2006), by combining local initiatives with national efforts to oversee trade, and foreign investments are unlikely to work unless national policies and legislatures create an enabling environment for controlling foreign investments' interventions and undertakings on the ground.

Changes in environmental conditions

Apart from the influence of marketing strategies, the changing environmental conditions also pose challenges to people's livelihoods (Table 4). The falling sea level and increasing sea temperatures (Moshy et al., 2012) mostly affected elderly fishers because they could not resort to pull-net and octopus-fishing practices through diving. Most of them resorted to palm weaving, basket-trap making, net-mending, vessel repair and farming, and received low earnings. Few elders were still engaged in pull-net fishery

Environmental conditions	Related processes	Outcomes	Response strategies
Falling sea level; increasing sea temperatures	Reduced fish populations in shallow areas; poor seaweed growth; inability to anchor vessels on traditional areas	Decreased individual fish catches; women octopus fishers no longer caught fish; decreased seaweed harvests; increased transportation costs	Fished in deeper waters; women contributed household income; alternated seaweed culture location and timing
Increasing wind and speed of ocean currents	Rougher ocean conditions hampered gill-net setting or swept them away; caused accidents; blew dust onto seaweed and caused decay; blew away seaweed poles	Decreased catches; loss of life, property, and income; Reduced seaweed productivity	Avoided deeper waters; fished in the same areas to support one-another; reduced seaweed harvesting time from six to three spring tides
Increasing climate variability	Prolonged dry seasons affect plant growth; livelihoods functioning; fish migration to deeper water	Decreased fish catches and crop productivity	
Decreasing soil qualities	Constrained farming activities	Decreased crop productivity	Chole people farmed on Juani Island; sought extension officers' support
Southerly monsoon winds	Winds damaged fishing vessels; constrained fishers to reach outer reefs	Decreased fish catches	Fished in inner reefs; focused in octopus-fishing
Northerly monsoon winds	Winds blew green algae that invaded octopus caves and seaweed	Reduced octopus catches and seaweed harvests	Removed algae manually from the harvest; focused on fish fishery in outer reefs
Rainy season	Inability to: work in the rain, dry fish and seaweed; fall in price for local produce; closure of tourism operations; thatch decomposition	Slowed down most activities; low productivity	Resumed activities after rains or season
Dry seasons	Fish migrated further into deep cooler waters; shortages of fresh water and grazing grasses	Fishing became harder and less productive; crop damage by livestock	Jibondo people collected water from Utende but lost fishing time; sought extension officers' support; fenced their farms; planted non-grazed crops; abandoned agriculture

Table 4: Changes in environmental conditions and their implications on livelihoods.

to provide their ecological knowledge, wisdom and advice to the fishing group. Through elderly engagement, fishers transformed structural knowledge into functional knowledge (Berkes et al., 2003). They built capacity by learning ecological knowledge and then practised it during fishing to maximize fishing efficiency while also providing opportunities for elders to continue with the fishery without diving.

Pull-nets involved strong able-bodied men diving to search for schools of fish to guarantee availability of catch. Those able-bodied unwilling to operate in groups or to face MIMP patrols opted for octopus-diving. However, diving caused chest pains and ear ruptures due to frequent free diving and breath-holding process. Pull-nets were also operated by about 30 fishers per vessel resulting in low income per individual fisher. The nets were frequently confiscated, and thus trapped fishers in debts. The skills for pull-net and octopus-diving were learnt from visiting fishers from southern Tanzania; reflecting the community's capacity to absorb social learning and/or ability to combine local and external experiences (Folke et al., 2003). However, fishers were also exposed to deep-water gill-net fishing by visiting fishers from Pemba every northern monsoon period but did not adopt it because it was perceived to be risky. This can imply that local fishers traded off potential economic benefits to ensure their safety (Brown and Westaway, 2011; Magis, 2010).

While the challenge of low crop productivity mainly resulted from a prolonged dry season, decreasing soil qualities and abandonment of agriculture, it was further extenuated by extension officers. The officers did not visit fields in Chole to deal with plant diseases or to solve persistent disputes between farmers and livestock keepers in Jibondo, where many farmers abandoned agricultural activities because livestock free-grazing caused recurrence of crop damage, and fencing was laborious and ineffective as livestock keepers often broke the fences and grazed their cattle on the farms. Although most respondents (59 per cent) at Jibondo owned farming plots and 36 per cent owned gardens around their homesteads, district agricultural officials explained that extension services were concentrated in Northern Mafia because Jibondo had been removed from their list after been re-categorized as a fishing village, while Chole was categorized as having little farming.

The decrease in seaweed productivity was a livelihood challenge that was also confirmed by seaweed agents, whose collections per springtide dropped from 25 tonnes during 1999–2006 to 5–10 tonnes since 2007. At the same time, seaweed farmers experienced seaweed decay from warmer oceanic conditions and seasonal turbidity. Hence farmers in Jibondo began to experiment by alternating farming locations and timing. During July to September they farmed in the Kitalani area, in Dongoni during September to November and in Rungi during October to April. Meanwhile, the Pwani Walani area was still under experimentation and was farmed throughout the year to determine suitable months. They innovated by using empty plastic bottles when the buoys became unavailable and farmed seaweed in less than knee depth to minimize injuries. The reduction of harvesting time slightly minimized losses from seaweed decay but removal of green algae from the harvest was, however, laborious and time-demanding.

These responses demonstrate the ability of respondents to combine local experiences with conventional science because seaweed culture training by Zanzibar Agro-Seaweed Company in 1986 and MIMP in 1998 directed villagers to farm at knee depth and harvest after six spring tides. Furthermore, the adjustments to environmental-related changes reflect the nature of human agency in making choices (Brown and Westaway, 2011) and the ability to transform crisis into opportunity to enhance livelihood resilience (Folke et al., 2005). These responses also support the argument by Perry et al. (2010) that emphasize a shift from uni-directional concepts that disregard how environmental processes stress humans (Charles, 2012).

Local notions of well-being

Overall, people experienced stress in their livelihoods such that their current state of being remained undesirable to the majority. Interviewees explained that their responses could not address most pressing challenges effectively hence they mainly experienced hardships rather than good life. This was partly because most of the challenges were influenced by national and global factors which were beyond their control. As such, respondents show cross-scale collaborations remain crucial to foster well-being among Park residents. When respondents were asked what should be done to ensure well-being of both people and environment, they provided multiple responses. In Chole, the top-most frequently mentioned measure was the need for MIMP to revise zoning scheme (49 per cent), whereas in Jibondo, the need for government to support fishers to own advanced fishing vessels and gears (50 per cent) was mostly mentioned. Other mentioned measures were the need for MIMP to provide credits in all fishing practices; substitute forceful beatings with dialogue and education; ensure alternative activities are feasible before stopping fishing; leave protection to local people and provide them with government assistance; foster genuine participation in decision-making; involve fishers in tourism activities; revolve rotational scheme in octopus fishery and to stop dynamite fishing elsewhere.

Furthermore, respondents mentioned the need for government to support fishers to access markets and determine price; invest on non-fishing activities; assess thoroughly on efficacy of fishing gears and well-being of all groups, particularly the elderly; construct fish processing plants in villages; ensure availability of extension officers for providing advice and training; supply water in villages; and separate fisheries management and fishers from politics. They also mentioned the need for fishing communities to ensure fish are available for consumption; establish new fishing groups and improve existing ones; save money instead of getting drunk; avoid damaging corals and extracting juvenile fish; migrate to other places; build better housing and to plant trees to reduce warmer conditions. However, impressions from interviews and FGDs mainly demonstrated little hope for obtaining desirable 'good life'. The mentioned cross-scale attributes of good life or SER imply benefits of responses by interviewees and potentials of adaptive conservation by the MIMP were not fully realized to stop regime shift to

undesired state and to promote societal development as envisaged in resilience thinking (Beymer-Farris et al., 2012; Folke et al., 2005). The shifting livelihood situations into undesirable states in this study include the shifts from engine to sail fishing vessels, large to small/juvenile fish consumption and food production to purchase.

Conclusions

This article investigates the struggles of fishing communities in an MPA to maintain their living in the face of multiple challenges. Villagers experienced worsened living conditions, reduced capacity to meet their basic needs, changing gender responsibilities, reduced access to key fishing grounds, and low productivity and prices of local produce. Their main responses included reduced expenditure, loan seeking, skipping meals, livelihood diversification, collective fishing, changing or abandoning fishing practices or activities, and outward migration. However, these responses only contributed to survival rather than resolving the challenges or attaining meaningful livelihood improvements.

Some responses and practices either strengthened or weakened people's resilience to social–ecological changes. Elements that strengthened their resilience were social capital and networks, self-organization, collective actions, social learning and transferring of social memory about initial agreements with the MIMP, focus on children's education and ability to retain ecological knowledge while also learning, sharing and experimenting new methods in fishing and seaweed culture. However, changing women responsibilities and increased livestock keeping at Jibondo, and increased farming at Chole strengthened resilience on one level and weakened it on another. Practices that weakened resilience included rigid management approaches that focus on environmental rather than social aspects, unviable livelihood activities, and unequal power relations between: villagers and MIMP officials; fishers and fish traders; livestock owners and farmers; and men octopus divers and women octopus fishers.

Persisting difficulties in fulfilling basic needs despite years of marine finfish export policy trial and MIMP operations means that MIMP's envisaged objective for ensuring park residents share the benefits of park operations (URT, 2000) and strategies for promoting sustainable livelihoods (URT, 2011, p. 38) have not been achieved. It also means household responses to changes in conservation and marketing strategies have failed to overcome MIMP conservation interventions and capitalist market economy forces to ensure their livelihood resilience and achieve desired social well-being. Improving institutional diversity and multi-sectoral collaborations is necessary because villagers face multiple social–ecological constraints. While conservation policies may have the potential for improving local living conditions, this is not achieved unless local vulnerabilities and resilience factors are clearly understood and articulated with respect to conservation interventions. Blind pursuits of conservation goals at the expense of the social, economic and cultural conditions that change in the processes may have negative outcomes on long-term SER as this study has illustrated.

Acknowledgments

This work resulted from the generous contributions by Chole and Jibondo fishing communities and support from government authorities at village and district levels, and by MIMP officials. The work was supported by the Norwegian Programme for Development, Research and Education [NUFUTZ 2007/10227]. We are thankful to Claude Mung'ong'o and the anonymous reviewers for providing insightful comments on the article.

Notes on contributors

Victoria H. Moshy is a Ph.D. student in Development Studies at the Norwegian University of Life Sciences, and Assistant Lecturer at the University of Dar es Salaam, Tanzania. Her present research interest is on human–environment interactions, focusing on the social aspects of social–ecological resilience and coastal and marine conservation.

Ian Bryceson is Professor of Ecology at the Department of International Environment and Development Studies, Norwegian University of Life Sciences. He is a marine ecologist with a research focus on fisheries, aquaculture and the struggles of coastal peoples for their rights. The core of his research focuses on socio-ecological resilience at the interphase of society and environment. He has published widely in international journals and has been actively involved in international public debates on land, coastal resource and human rights.

Rosemarie Mwaipopo is a senior lecturer at the Department of Sociology and Anthropology at the University of Dar es Salaam, Tanzania. Her research areas are on gender issues, human–environment interactions with a focus on coastal communities and artisanal and small-scale mining communities. She has published widely in these fields.

References

- Adger, W. N., 2000, 'Social and ecological resilience: Are they related?', *Progress in Human Geography*, Vol. 24, pp. 347–364.
- Allison, E. H. and F. Ellis, 2001, 'The livelihoods approach and management of small-scale fisheries', *Marine Policy*, Vol. 25, pp. 377–388.
- Baker, A., 2013, *Marine research programme: Utende beach Mafia Island Tanzania*, TZM Phase 132 Science report, FRONTIER Tanzania.
- Béné, C., 2009, 'Are fishers poor or vulnerable? Assessing economic vulnerability in small scale fishing communities', *Journal of Development Studies*, Vol. 45, No. 6, pp. 911–933.
- Benjaminsen, T. A. and I. Bryceson, 2012, 'Conservation, green/blue grabbing and accumulation by dispossession in Tanzania', *Journal of Peasant Studies*, Vol. 39, No. 2, pp. 335–355.
- Berkes, F., 2003, 'Alternative to conventional management: Lessons from small-scale fisheries', *Environments*, Vol. 31, No. 1, pp. 5–20.
- Berkes, F., J. Colding and C. Folke, eds, 2003, *Navigating Social-ecological Systems: Building Resilience for Complexity and Change*, Cambridge: Cambridge University Press.
- Berkes, F. and C. Folke, eds, 1998, *Linking Social and Ecological Systems: Management Practices and Social Mechanisms for Building Resilience*, Cambridge: Cambridge University Press.
- Berkes, F. and C. Seixas, 2005, 'Building resilience in lagoon social-ecological system: A local-level perspective', *Ecosystems*, Vol. 8, pp. 967–974.

- Beymer-Farris, B. A., T. J. Basset and I. Bryceson, 2012, Promises and pitfalls of adaptive management in resilience thinking: The lens of political ecology, in T. Plieninger and C. Bieling, eds, *Resilience in the Cultural Landscape*, Cambridge: Cambridge University Press, pp. 283–299.
- Blaikie, P., 1985, *The Political Economy of Soil Erosion in Developing Countries*, London: Longman.
- Blaikie, P. and H. Brookfield, 1987, *Land Degradation and Society*, London: Methuen.
- Brockington, D. R., R. Duffy and J. Igoe, 2008, *Nature Unbound: Conservation, Capitalism and the Future of Protected Areas*, London: Earthscan.
- Brown, K. 2013, 'Global environmental change: A social turn for resilience?', *Progress in Human Geography*, doi:10.1177/0309132513498837.
- Brown, K. and E. Westaway, 2011, 'Agency, capacity, and resilience to environmental change: Lessons from human development, wellbeing and disasters', *The Annual Review of Environment and Resources*, Vol. 36, pp. 321–342.
- Bryant, R. L. and S. Bailey, 1997, *Third World Political Ecology: An Introduction*, London: Routledge.
- Bryceson, I., N. Jiddawi, A. Kamukuru, K. Kulindwa, R. Mwaipopo, P. Onyango and M. Sebastian, 2006, *Fisheries Study in Tanzania Coastal Waters: The Effects of Trial Export of Finfish from Mafia Island on Social-ecological Resilience and Vulnerability*. Report to the Ministry of Natural Resources and Tourism and the Norwegian Embassy [Unpublished report].
- Bryman, A., 2004, *Social Research Methods*, New York: Oxford University Press.
- Bunce, M., S. Rosendo and K. Brown, 2010, 'Perceptions of climate change, multiple stressors and livelihoods on marginal African coasts', *Environment Development & Sustainability*, Vol. 12, pp. 407–440.
- Caplan, C., 2002, *Local understanding of modernity: Food and food security on mafia Island, Tanzania*. Report, Tanzania Commission for Science and Technology (COSTECH), Dar es Salaam, Tanzania.
- Caplan, P., 2007, 'Between socialism and neoliberalism: Mafia Island, Tanzania, 1965–2004', *Review of African Political Economy*, Vol. 114, pp. 679–694.
- Chambers, R. and G. Conway, 1992, *Sustainable livelihoods: Practical concepts for the 21st century*, IDS Discussion Paper 296, Institute for Development Studies, UK.
- Charles, A., 2012, 'People, oceans and scale: Governance, livelihoods and climate change adaptation in marine social-ecological systems', *Current opinion in Environmental Sustainability*, Vol. 4, pp. 351–357.
- Christensen, L. and N. Krogman, 2012, 'Social thresholds and their translation into social-ecological management practices', *Ecology and Society*, Vol. 17, No. 1, article no. 5, <http://dx.doi.org/10.5751/ES-04499-170105>.
- Coulson, A., 2013, *Tanzania: A Political Economy*, Oxford: Oxford University Press.
- Coulthard, S., 2012, 'Can we be both resilient and well, and what choices do people have? Incorporating agency into the resilience debate from a fisheries perspective', *Ecology and Society*, Vol. 17, No. 1, article no. 4, <http://dx.doi.org/10.5751/ES-04483-170104>.
- Cretny, R. and S. Bond, 2014, '“Bouncing back” to capitalism? Grass-roots autonomous activism in shaping discourses of resilience and transformation following disaster', *Resilience: International Policies, Practices and Discourses*, Vol. 2, No. 1, pp. 18–31.
- Crona, B., M. Nystrom, C. Folke and N. Jiddawi, 2010, 'Middlemen, a critical social-ecological link in coastal communities of Kenya and Zanzibar', *Marine Policy*, Vol. 34, pp. 761–771.

- Darling, E. S., 2014, Assessing the effect of marine reserves on household food security in Kenyan coral reef fishing communities, *PLoS ONE* Vol. 9, No. 11, p. e113614. doi:10.1371/journal.pone.0113614.
- Davidson, D. J., 2010, 'The applicability of the concept of resilience to social systems: Some sources of optimism and nagging doubts', *Society and Natural Resource*, Vol. 23, No. 12, pp. 1135–1149.
- Ellis, F., 2000, *Rural Livelihoods and Diversity in Developing Countries*, Oxford: Oxford University Press.
- Fabinyi, M., L. Evans and S. J. Foale, 2014, 'Social-ecological systems, social diversity, and power: Insights from anthropology and political ecology', *Ecology and Society*, Vol. 19, No. 4, article no. 28, <http://dx.doi.org/10.5751/ES-07029-190428>.
- FAO, 2010, *The State of Food Insecurity in the World*, Rome: FAO.
- Foale, S., D. Adhuri, P. Allin, E. H. Allison, N. Andrew, P. Cohen, L. Evans, M. Fabinyi, P. Fidelman, C. Gregory, N. Stacey, J. Tanzer and N. Weeratunge, 2013, 'Food security in the Coral Triangle Initiative', *Marine Policy*, Vol. 38, pp. 174–183.
- Folke, C., S. R. Carpenter, B. Walker, M. Scheffer, T. Chapin and J. Rockström, 2010, 'Resilience thinking: Integrating resilience, adaptability and transformability', *Ecology and Society*, Vol. 15, No. 4, article no. 20, <http://www.ecologyandsociety.org/vol15/iss4/art20/>.
- Folke, C. J., J. Colding and F. Berkes, 2003, Synthesis: building resilience and adaptive capacity in social-ecological systems, in F. Berkes, J. Colding and C. Folke, eds, *Navigating Social-ecological Systems: Building Resilience for Complexity and Change*, Cambridge: Cambridge University Press, pp. 352–387.
- Folke, C., T. Hahn, P. Olsson and J. Norberg, 2005, 'Adaptive governance of social-ecological systems', *Annual Review Environment Resources*, Vol. 30, pp. 441–473.
- Hardy, P., C. Béné, L. Doyen and A. Schwarz, 2013, 'Food security versus environment conservation: A case study of Solomon Islands' small-scale fisheries', *Environmental Development*, Vol. 8, pp. 38–56.
- Harvey, D., 2005, *A Brief History of Neoliberalism*, Oxford: Oxford University Press.
- Hauzer, M., P. Dearden and G. Murray, 2013, 'The fisherwomen of Ngazija Island, Comoros: Fisheries livelihoods, impacts, and implications for management', *Fisheries Research*, Vol. 140, pp. 28–35.
- Jennings, S. and N. V. C. Polunin, 1996, 'Impacts of fishing on tropical reef ecosystems', *AMBIO*, Vol. 25, No. 1, pp. 44–49.
- Jones, J. B., 1992, 'Environmental impact of trawling on the seabed: A review', *New Zealand Journal of Marine and Freshwater Research*, Vol. 26, No. 1, pp. 59–67.
- Jones, P. J. S., W. Qiu and E. M. DeSanto, 2013, 'Governing marine protected areas: Social-ecological resilience through institutional diversity', *Marine Policy*, Vol. 41, pp. 5–13.
- Kolding, J. and P. A. M. Zwieten, 2011, 'The tragedy of our legacy: How do global management discourses affect small scale fisheries in the South?', *Forum for Development Studies*, Vol. 38, No. 3, pp. 267–297.
- Leslie, P. and T. McCabe, 2013, 'Response diversity and resilience in social-ecological systems', *Current Anthropology*, Vol. 54, No. 2, pp. 114–143.
- Mackinnon, D. and K. D. Derickson, 2013, 'From resilience to resourcefulness: A critique of resilience policy and activism', *Progress in Human Geography*, Vol. 37, pp. 253–270.
- Magis, K., 2010, 'Community resilience: An indicator of social sustainability', *Society and Natural Resources*, Vol. 23, No. 5, pp. 401–416.

- Marschke, M. J. and F. Berkes, 2006, 'Exploring strategies that build livelihood resilience: A case from Cambodia', *Ecology and Society*, Vol. 11, No. 1, article no. 42, <http://www.ecologyandsociety.org/vol11/iss1/art42/>.
- Marshall, N., P. Marshall and A. Abdulla, 2009, 'Using social resilience and resource dependency to increase the effectiveness of marine conservation initiatives in Salum, Egypt', *Journal of Environmental Planning and Management*, Vol. 52, No. 7, pp. 901–918.
- Mascia, M. B., C. A. Claus and R. Naidoo, 2010, 'Impacts of marine protected areas on fishing communities', *Conservation Biology*, Vol. 24, No. 5, pp. 1424–1429.
- McClanahan, T. R., J. Cinner, A. T. Kamukuru, C. Abunge and J. Ndagala, 2009, 'Management preferences, perceived benefits and conflicts among resource users and managers in the Mafia Island Marine Park, Tanzania', *Environmental Conservation*, Vol. 35, No. 4, pp. 340–350.
- Mora, C. and P. F. Sale, 2011, 'Ongoing global biodiversity loss and the need to move beyond protected areas: A review of the technical and practical shortcomings of protected areas on land and sea', *Marine Ecology Progress Series*, Vol. 434, pp. 251–266.
- Moshy, V., I. Bryceson and B. Beymer-Farris, 2012, *Seeing through fishers' lenses: Exploring marine ecological changes within Mafia Island, Tanzania*. Proceedings of the International Conference on Fisheries and Marine Science (Marine Fish 2012), Negombo, Sri Lanka.
- Moshy, V. H., T. J. Masenge and I. Bryceson, 2013, 'Undernutrition among under-five children in two fishing communities in Mafia Island Marine Park, Tanzania', *Journal of Sustainable Development*, Vol. 6, No. 6, pp. 1–14.
- Mwaipopo, R. N., 2008, *The Social Dimensions of Marine Protected Areas: A Case Study of Mafia Island Marine Park Tanzania*, Samudra Monograph, Chennai: International Collective in Support of Fishworkers.
- Narayan, D. and L. Pritchett, 1999, 'Cents and sociability: Household income and social capital in rural Tanzania', *Economic Development and Cultural Change*, Vol. 47, No. 4, pp. 871–897.
- Onyango, P. and S. Jentoft, 2013, Poverty in Lake Victorian fisheries: Understanding governability, in M. Bavinck, R. Chuenpagdee, S. Jentoft and J. Kooiman, eds, *Governability of Fisheries and Aquaculture: Theory and Applications*, Dordrecht: Springer Netherlands, pp. 155–175.
- Perry, R. I., M. Barange and R. E. Ommer, 2010, 'Global changes in marine systems: A social-ecological approach', *Progress in Oceanography*, Vol. 87, pp. 331–337.
- URT, 2000, *Mafia Island Marine Park General Management Plan*, Marine Parks and Reserves, Dar es Salaam: Jamana Printers.
- URT, 2011, *Mafia Island Marine Park: General management plan*, Dar es Salaam: Board of Trustees for Marine Parks and Reserves.
- Walker, B., C. S. Holling, S. Carpenter and A. Kinzig, 2004, 'Resilience, adaptability and transformability in social-ecological systems', *Ecology and Society*, Vol. 9, No. 2, article no. 5, <http://www.ecologyandsociety.org/vol9/iss2/art5>.
- Walley, C., 2004, *Rough Waters: Nature and Development in an East African Marine Park*, Princeton, NJ: Princeton University Press.