

Vulnerability and marine resource-dependence in coastal and marine social-ecological systems



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If you want to go fast, go alone.

If you want to go far, go together.

~ African Proverb

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List of abbreviations

BMBF	German Ministry of Education and Research (<i>Bundesministerium für Bildung und Forschung</i>)
CM-SES	Coastal and Marine Social-Ecological Systems
CPUE	Catch per Unit Effort
DAAD	German Academic Exchange Service (<i>Deutscher Akademischer Austauschdienst</i>)
DFID	Department for International Development
EAFM	Ecosystem Approach to Fisheries Management
FAO	Food and Agricultural Organisation
FAOLEX	Food and Agricultural Organisation legal database
GDP	Gross Domestic Product
IMS	Institute for Marine Sciences, Zanzibar
IUCN	International Union for the Conservation of Nature
KKP	Indonesian Ministry of Marine Affairs and Fisheries (<i>Kementerian Kelautan dan Perikanan</i>)
MPA	Marine Protected Area
MSL	Material Style of Life
NGO	Non-Governmental Organisation
SES	Social-Ecological System
SFLP	Sustainable Fisheries Livelihoods Program
SLA	Sustainable Livelihoods Approach
SPICE	Science for the Protection of Indonesian Coastal Ecosystems
ZMT	Leibniz Center for Tropical Marine Ecology (<i>Leibniz Zentrum für Marine Tropenökologie</i>)

List of published papers

The following papers will be submitted as part of this thesis and are referred to in the text by their number in **bold**.

- Chapter 1** **Ferrol-Schulte D**; Wolff M; Ferse, S; Glaser M. (2013) Sustainable Livelihoods Approach in tropical coastal and marine social – ecological systems: a review. *Marine Policy* 42:253–258
- Chapter 2** **Ferrol-Schulte D**; Ferse, S; Glaser, M. (2014) Patron-Client Relationships, Livelihoods and Natural Resource Management in Tropical Coastal Communities. *Ocean and Coastal Management* 100:63-73
- Chapter 3** **Ferrol-Schulte, D**; Gorris, P; Baitoningsih, W; Adhuri, D; Ferse, S. (2015) Coastal livelihood vulnerability to marine resource degradation: a review of the Indonesian national coastal and marine policy framework. *Marine Policy* 52:163-171

My contribution to each of the papers listed above is as follows:

- (Chapter 1)** Responsible for literature survey and largest share of the writing.
- (Chapter 2)** Responsible for method design, field work, data analysis and largest share of the writing.
- (Chapter 3)** Responsible for coordination of data collection, analysis and largest share of the writing.

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Abstract

Vulnerability research in coastal and marine social-ecological systems (CM-SES) to date has focused primarily on conceptual analyses of exposure, sensitivity and adaptive capacity. Meanwhile the Sustainable Livelihoods Approach (SLA) has been utilized mainly in natural resource management or poverty alleviation strategies. The present thesis combines these two frameworks in order to investigate the relationships between marine resource dependence and vulnerability within the CM-SES, using the SLA as a point of departure for analysis. Using a case study approach, questionnaires, key informant interviews, focus groups and participant observation were carried out in two regions, Zanzibar, Tanzania and the Spermonde Archipelago, Indonesia.

The thesis begins by asking whether the SLA is an appropriate tool for evaluating CM-SES (**Chapter 1**). After identifying the strengths and weaknesses of this framework, research then moves onto using the lessons learned in **Chapter 1** to analyse the effect of patron-client systems on coastal household vulnerability through the lens of the first two sections of the SLA (**Chapter 2**). Patrons are found to be drivers of and influential actors in relation to marine resource dependence. Using the example of Indonesia, the thesis then asks to what degree the second part of the SLA, the vulnerability context, is influenced by national policy frameworks on vulnerability mitigation (**Chapter 3**). Although a focus on adaptive capacity is favourable, in this case ignoring issues of exposure and sensitivity to coastal vulnerability is tantamount to treating just the symptoms of a disease, rather than the cause. The final two parts of the SLA, livelihood strategies and outcomes, are the focus of **Chapter 4**. This chapter empirically tests the idea that livelihood diversity is directly related to food security, a factor used to gauge coastal vulnerability. In both regions, the links between these three factors were found to be weak, at best, indicating that current vulnerability mitigating strategies may need to focus their investigations at a higher resolution at the cost of generalizability.

The findings demonstrate that marine resource dependence in the form it takes in either research region may not be able to mitigate vulnerability. Rather, the key to addressing marine ecosystem degradation and decline and poverty lies in understanding and appreciating the finer details that drive marine resource dependence. Furthermore, strategies such as livelihood diversification may not lead coastal communities into a state of lesser vulnerability as is often presumed. These findings have profound implications for conservation and development, highlighting that scientists, decision-makers and practitioners need to embrace vulnerability as an integrated, interdisciplinary and intricate concept.

Deutsche Zusammenfassung

Bisher hat sich die Vulnerabilitäts-Forschung in sozial-ökologischen Küsten- und Meeres-Systemen (KM-SÖS) überwiegend auf die konzeptuelle Analyse von Aussetzung, Sensibilität und adaptiver Kapazität fokussiert. Währenddessen/Gleichzeitig wurde der Sustainable Livelihoods-Ansatz(SLA) vor allem im Management natürlicher Ressourcen oder bei Strategien zur Armutsminderung verwendet. Die vorliegende Arbeit kombiniert diese beiden Rahmenkonzepte, um die Verhältnisse zwischen Abhängigkeit von Meeresressourcen in Küstengemeinden zu Vulnerabilitäts-Ausgleichsmassnahmen in KM-SÖS zu untersuchen. Der SLA wird hierfür als Ausgangspunkt der Analyse verwendet. Die methodische Herangehensweise basiert auf Fallstudien in zwei Regionen - Zanzibar in Tanzania und Spermonde Archipelago in Indonesien - in denen eine Befragung mit Fragebögen, Key Informant Interviews, Fokusgruppen und teilnehmende Beobachtung durchgeführt wurden.

Die Arbeit beginnt mit der Fragestellung, ob der SLA ein angemessenes Werkzeug für die Evaluierung von KM-SÖS ist (**Kapitel 1**). Nach der Identifizierung der Stärken und Schwächen dieses Konzeptes setzt sich die Forschung dann fort mit der Verwendung der in Chapter 1 gewonnenen Erkenntnisse für eine Analyse der Auswirkungen von Paten-Klienten-Systemen auf die Vulnerabilität von Küsten-Haushalten anhand der ersten beiden Bereiche des SLA (**Kapitel 2**). Fischer-Paten stellen sich in Bezug auf die Abhängigkeit von Meeresressourcen als massgebliche treibende Kräfte und einflussreiche Akteure heraus. Als nächstes untersucht die Arbeit anhand des Beispiels Indonesien, in welchem Maße der zweite Bereich des SLA, der Vulnerabilitäts-Kontext, von dem nationalen Regelwerk bezüglich Vulnerabilitäts-Ausgleichsmassnahmen beeinflusst ist (**Kapitel 3**). Obwohl ein Fokus auf adaptive Kapazität(en) generell vielversprechend ist, tritt in diesem Falle eine geringfügige Beachtung der Themen Aussetzung und Sensitivität bezüglich Küsten-Vulnerabilität zu Tage, was einer Behandlung der Symptome anstatt der Ursachen der Krankheit entspricht. Die letzten beiden Teile des SLA, Livelihood-Strategien und ihre Folgen, sind der Fokus von **Kapitel 4**. Das Kapitel testet empirisch die Idee, dass Livelihood-Diversität mit verbesserter Nahrungssicherheit, welches ein massgebender Faktor für verringerte Küsten-Vulnerabilität ist, zusammenhängt. In beiden Regionen (Zanzibar und Spermonde) stellte sich die Verbindung dieser drei Faktoren als (im besten Falle) schwach heraus, was darauf hinweist, dass sich derzeitige Vulnerabilitäts-Ausgleichsstrategien besser auf eine höhere Detail-Auflösung ausrichten sollten, wenn auch auf Kosten der Generalisierbarkeit.

Die Ergebnisse aus den jeweils erforschten Regionen zeigen, dass Meeres-Ressourcen-Abhängigkeit potentiell nicht in der Lage sein wird, Vulnerabilität auszugleichen. Eher wird der Schlüssel, um Armut und Ökosystem-Degradierung im Küstenbereich anzugehen, darin liegen, die feineren Details, welche die Meeres-Ressourcen-Abhängigkeit antreiben, zu verstehen und zu würdigen. Des Weiteren werden Strategien wie Livelihood-Diversifizierung und Zugang zu größeren finanziellen Ressourcen nicht zwangsläufig dazu beitragen, Küstengemeinden in einen Zustand geringerer Vulnerabilität zu bringen, wie oft angenommen wird. Diese Ergebnisse haben tiefgreifende Auswirkungen für Umweltschutz und Entwicklung, da sie hervorheben, dass Wissenschaftler, Entscheidungsträger und praktische Anwender Vulnerabilität als integriertes, interdisziplinäres und komplexes Konzept wahrnehmen und ihr entsprechend begegnen müssen.

Introduction

Understanding how humans interact with and depend on nature has long been accepted as crucial to managing the environment (Glaser et al. 2012c). The concept of linked, adaptive social-ecological systems (SES) provides a dynamic and relevant framework with which it becomes possible to engage in more integrated and holistic thinking when it comes to human connections with nature (Folke 2006; Glaeser et al. 2009; Perry and Ommer 2010). The feedback mechanisms incorporated in the SES framework, whereby humans influence nature and vice versa, mean that what affects one component or dynamic interaction between components has consequences for the wider complex adaptive system (Norberg and Cumming 2008) and influences its composition and trajectory (Gallopín 2006).

Humans and nature exist in a state of interconnectedness and interdependence, continually shaping and restructuring each other through dynamic flows, feedbacks and interaction between social and ecological system components (Folke 2006). An SES can be understood as a “bio-geophysical system with its associated social agents and institutions in a problem context” (Glaser et al. 2010b). The social and ecological components of a CM-SES and the dynamic links between them do not exist in isolation, but are subject to changes, be they sudden shocks and/or long-term trends (Allison and Ellis 2001; Allison and Horemans 2006; Pomeroy et al. 2006). The ability of a CM-SES to absorb such changes and still retain basic structure and function depends on the degree and type(s) of vulnerability with which it is associated (Adger 2006) and its degree of what is known as ‘resilience’ (Walker et al. 2002; Walker and Salt 2006).

Resilience and vulnerability theory share their origins in ecological theory. The concept of the adaptive cycle within ecological systems, where self-reinforcing mechanisms contribute to system stability and function in the face of stress and/or change, can be applied to SES (Gunderson and Holling 2002; Walker et al. 2002). The loss of key functional species through, for example, overfishing, can directly impact upon the well-being of the ecosystem as a whole (McClanahan and Muthiga 1988; Moberg and Folke 1999). Although key functions in marine ecosystems may continue, reduced biodiversity can mean a diminished capacity to absorb changes and shocks. Reduced resilience renders ecological systems vulnerable to cascading effects and in some cases leads to complete regime shifts to new, stable states (Holling 1973; Holling 1986).

Vulnerability as a concept is itself multi-faceted, including exposure and sensitivity to changes and the system’s ability to adapt (adaptive capacity) (Folke et al. 2002; Adger 2006; Gallopín 2006; McClanahan and Cinner 2011). Vulnerability is defined by Adger as “the state of susceptibility to harm from exposure to stresses associated with environmental and social change and from the absence of capacity to adapt” (Adger 2006). Vulnerability refers to the risk or exposure to trends (long-term) and shocks (short-term) that a system may be subjected to (Turner et al. 2003).

The recognition of resilience-thinking and vulnerability as integral for adaptive management of marine ecosystems has meant that these concepts have been linked to social systems (Walker et al. 2002; Folke 2006). The divergent origins of these perspectives have, over the last few decades, converged and come to be seen as central to SES analysis and effective, adaptive management (Berkes and Folke 1998; Anderies et al. 2004; Olsson et al. 2004; Janssen et al. 2006; Gallopín 2006; Rammel et al. 2007; United Nations Secretary-General’s High-Level Panel on Global Sustainability 2012).

This thesis identifies sources of vulnerability in the CM-SES linked to marine resource dependence in tropical coastal communities. Coastal communities are highly reliant on natural resources for their livelihoods (Tundi et al. 2005; Pomeroy et al. 2006; Cullen 2007; Bunce et al. 2009; Burke et al.

2011), with around 250 million people worldwide depending directly on coral reefs alone (United Nations General Assembly 2011). Some 12% of the world's population depend on fisheries and aquaculture (Food and Agriculture Organization (FAO) 2014). The state of human well-being in tropical coastal areas is often related to the health of the ecosystem and natural resources upon which human communities depend. The decline and degradation of natural systems as a result of overfishing, pollution, climate change, and ocean acidification, amongst other drivers, poses significant threats to marine and coastal ecosystems, their functions (United Nations General Assembly 2011), and the resilience of the CM-SES overall (Walker et al. 2002; Crona 2006; Glaeser et al. 2009; Ferrol-Schulte et al. 2013).

This thesis aims to assess vulnerability within coastal and marine social-ecological systems (CM-SES) and how it affects the livelihoods of those human communities who depend on marine natural resources within those systems. Globalisation, migration, development, improving and expanding communications infrastructures and economic fluctuations are having increasingly rapid effects on how coastal communities depend on and utilize the marine natural resources around them (Kramer et al. 2009). Meanwhile marine natural resources are being depleted at alarming rates, ecosystems are declining (Rhoe et al. 2005; Tundi et al. 2005; United Nations Environment Programme 2006) and even experiencing complete regime shifts (Folke et al. 2004). The combination of stressors on the CM-SES is furthermore exacerbated by climate change and ocean acidification, the consequences of which remain as varied as they are unpredictable (McClanahan and Cinner 2011; Cinner et al. 2012; Glaser et al. 2012a). Anthropogenic and natural threats work in concert and affect the CM-SES in its entirety, although anthropogenic threats appear to be the greater driver of marine and coastal ecosystem decline (United Nations Environment Programme 2006).

The ability to adapt to and survive global as well as local changes in the human and natural environment depends on how vulnerability is perceived and embraced (Clayton and Myers 2009; Berkes and Ross 2013), where solutions are sought and what sources of resilience are utilized, whilst learning to recognize and accept the unchangeable, the uncertain and the unpredictable. Since the 1980s, conservation and development efforts have begun to integrate, setting aside the previously fragmented approach to fundamental issues in human and environmental well-being, although the positive outcomes for poverty alleviation that result from such efforts have been shown in some cases to be limited to the implementation period of such projects (Gurney et al. 2014).

This thesis presents new insights on CM-SES vulnerability. The research focuses specifically on the vulnerabilities that relate to coastal livelihoods and their dependence on marine natural resources. The aim is to locate as yet under-represented sources of vulnerability for both the social and natural components and potential strategies to increase the resilience of the CM-SES as a complex adaptive system. Systems with a high degree of internal component diversity can be referred to as complex adaptive systems (CAS) (Levin 1999; Folke 2006). CAS comprise of a variety of system components that undergo non-linear interactions, which through self-reinforcing or self-moderating processes entail an inherent adaptability in the context of uncertainty and sudden change (Norberg and Cumming 2008). The ability of a system to re-organize, learn and adapt around change is a function of the diversity of and within the system components. Various regimes within a CAS will require different functional contributions of the many components of that system, and often in different proportions. The greater the diversity of and within the system component(s), the more likely it is that a functional trait will exist that can complement the new, post-disturbance regime. Indeed it is during times of change that diversity becomes most important: a varied system will have a greater number of possible response traits that can allow the system to cope under changing conditions. Response diversity refers to the degree of variation in response traits that a system comprises. Component and response diversity

are of especially high importance to sensitive ecological CAS such as coral reefs and social-ecological CAS such as fisheries (Elmqvist et al. 2003). Even removing functionally less important components can negatively impact upon response diversity and the ability of a CAS to adapt under changing circumstances, thereby degrading the system's resilience. For example, removing lower trophic level species can impact food chains by decreasing prey species, thereby reducing predator numbers and having an effect upon coral reef system diversity (Hirschfield 2005). Whilst this research is focused on the social components, their impact upon and relevance to ecological function and environmental integrity of the CM-SES is the ongoing theme throughout.

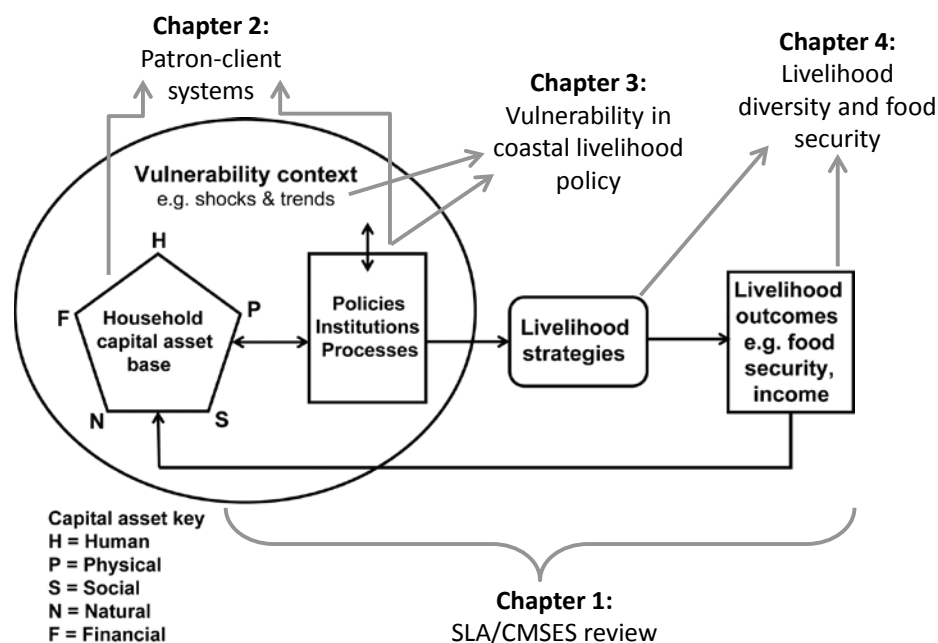
Scope of the thesis

Vulnerability within the CM-SES is a dynamic concept, requiring integrated and holistic approaches to mitigation (Adger 2006). Tropical coastal communities who highly depend on marine natural resources are often the most vulnerable, as well as being amongst the poorest in the world (Guillotreau et al. 2012; Krishnamurthy et al. 2014). This research uses the Sustainable Livelihoods Approach (SLA) (Department for International Development 1999) as a lens through which to evaluate vulnerability within the CM-SES as a function of marine resource-dependent livelihoods in tropical coastal communities. This framework has been used by non-governmental organizations such as the UN Food and Agricultural Organization (FAO) and CARE in order to identify and address problems associated with natural resource management in small-scale fisheries and poverty alleviation in coastal communities worldwide (see **Chapter 1**).

The thesis begins by seeking a deeper understanding of the SLA framework, its applications and its limitations (**Chapter 1**). For this paper, case studies were analysed from the previous 10 years of CM-SES management where the SLA was used either as an implementation or an evaluation tool. The aim was to identify the true value of using the SLA as a management or evaluation tool for CM-SES management and addressing marine resource-dependent livelihoods in tropical coastal communities. The results of this desk-based study showed that despite being heralded as holistic, participatory and dynamic (Morse et al. 2009), the SLA is not without its limitations. The framework does not protect decision-makers and practitioners from the eternal and often undermining challenges faced by many interventions relating to conservation and development: rights and access allocation, corruption, lack of local financial, intellectual and innovative capacity, and centralized governance. **Chapter 1** provides a realistic assessment of SLA-based research. The next paper (**Chapter 2**) uses the review of the SLA framework as a point of departure for examining the influence of patron-client systems within the CM-SES. This work is based on data collected on Zanzibar and builds on previous work by Crona et al. (2010). Patron-client systems have been found to pose challenges to (Ferse et al. 2012) as well as potentials for (Crona et al. 2010) natural resource management in small-scale fisheries. Similar work has been carried out in the Spermonde Archipelago (Pelras 2000; Ferse et al. 2012), and this paper aims to find synergies between the two case study areas. Despite being determining factors in the choice of fishing gear or through involvement in influential social networks, patrons or patron-client relationships are often not recognized or given adequate priority by conservation and development strategies, as per Ferse et al (2014). **Chapter 2** aims to delineate further what a patron-client relationship can mean for the coastal and marine ecosystem upon which coastal households depend and for conservation and development overall.

Conservation and development strategies are formulated and activated within an environment comprised of enabling and hindering factors, known as the vulnerability context. This is the focus of

Chapter 3, where the national policy framework of Indonesia is evaluated in light of its contribution to enabling and/or hindering factors within the Indonesian CM-SES vulnerability context. **Chapter 3** highlights the need for a comprehensive approach to mitigating vulnerability in the wake of Indonesia's decentralization and rapid economic development. Addressing issues of marine resource dependence in coastal communities requires embracing issues of exposure, sensitivity as well as adaptive capacity (see references above) within management strategies, even if a greater emphasis on building adaptive capacity, as seen in the Indonesian policy context, is justified (Webb and Harinarayan 1999; Barrett 2010; Hughes et al. 2012a; Krishnamurthy et al. 2014).



1

Figure 1 The Sustainable Livelihoods Approach (adapted from Department for International Development, 1999). The components of the SLA addressed in each chapter are also shown.

The final chapter, **Chapter 4**, completes the SLA framework by addressing livelihood strategies and outcomes in both case study regions, Zanzibar and the Spermonde Archipelago. Analysing sites in 2 distinct regions of the globe broadens the horizon in terms of looking for synergies amongst CM-SESs across regions. The link between vulnerability - as expressed by food security (Dilley and Boudreau 2001; Hughes et al. 2012a) - and livelihood diversity, expressed as the number of livelihoods, is the focus of this chapter. The decline of coastal and marine ecosystems can lead to tremendous impacts upon the coastal communities who depend on these ecosystems for their very survival (Hardy et al. 2013). The complex relationship between people and the ocean often is determined by food acquisition or a means to generate income in order to buy food. Dependence on marine natural resources, in this case, is direct and in some cases creates vulnerability. The advantage of using food security as a means to assess vulnerability is that this obvious form of human-nature interaction provides a platform where conservation and development can meet in order to address vulnerability in

an integrated, holistic and perhaps even more sustainable way (Harris et al. 2012). By focusing on the direct connections between coastal communities and the marine environment, there is less consideration given to the indirect links, such as fisheries-related employment (United Nations Environment Programme 2006; Food and Agriculture Organization (FAO) 2014) and tourism (Tao and Wall 2009; Daw et al. 2011), which can be equally important to a household's basic survival. Whereas livelihood diversification is a strategy often used by coastal households and practitioners to alleviate poverty and fluctuations in marine natural resources, the focus on food security in **Chapter 4** shows that, in both sites surveyed, the number of livelihoods is not significantly related to food security and that significant differences in livelihood diversity, food security, material style of life and debt exist between the two case study locations. This demonstrates further the fact that the integration of conservation and development strategies needs to be based on the local context and exposure to global changes. This final chapter highlights the importance of adaptive management and comprehensive planning underpinned by a realistic and qualitative appreciation of diversity within the social components of the CM-SES (Ferrol-Schulte et al. 2013; Fabinyi et al. 2014).

Research sites and methodology

This research takes place in two case study countries: Zanzibar and the Spermonde Archipelago in Indonesia. Both regions are subject to marine resource-dependence that can render a CM-SES more vulnerable to changes, ranging from local to global. Both case study sites are home to degraded coral reef ecosystems (Edinger et al. 1998; Jiddawi and Öhman 2002; Thyresson et al. 2013), exhibit marine-based patron-client relationships (Crona et al. 2010; Radjawali 2011; Deswandi 2012; Ferse et al. 2012), and have been shown to be dependent on links to growing global market trends (Lange and Jiddawi 2009; Schwerdtner Máñez and Ferse 2010; Radjawali 2011; Thyresson et al. 2013; Ferse et al. 2014). A study by Srinivasan and colleagues demonstrated that low-income and small island nations are most likely to be profoundly impacted by global marine catch losses due to overfishing as a result of their heavy dependence on marine resources for protein (Srinivasan et al. 2010). Although data was collected in two case study sites, this is not a comparative study. The two regions surveyed differ greatly in their bio-geographical and socio-cultural characteristics. A direct comparison would be scientifically unreliable and negligent of the advantages for mitigating vulnerability that their inherent diversity can provide. The advantage of using this approach is that having two case studies broadens the horizon of the lessons that can be learned from this research. The similarities between the two research sites mean that connections can be found within, for example, patron-client systems or CM-SES vulnerability, and the diversity of drivers and outcomes be highlighted more intensely.

Developments during the course of this research meant that the methods used to gather data on Zanzibar could not be replicated in Indonesia. The same questionnaire was used in both regions and in both cases in native tongue (more information on specific methodology can be found in the individual chapters). However one crucial difference remains. Whereas on Zanzibar, the surveying was carried out by the principle investigator along with an assistant, in Indonesia a research team of local scientists was trained by the principle investigator and data then gathered in her absence. The benefits of this approach are that data from Indonesia, which would otherwise not have been collected, could be incorporated into the analysis. The disadvantage of using such an approach is that there can be no control for response effects ranging from interviewing technique, deference or acquiescence, third-party presence or expectancy effects, or even perception of threatening questions (Russell Bernard 2006). Whereas the principle investigator's experience and familiarity with the research is of benefit to the data collected on Zanzibar, the Indonesian data was collected by a local team who were familiar with the Spermonde islands. Each case study is analysed separately. The diversity of each research site

and the two different methods of implementation do not detract from the value of the conclusions drawn in this thesis.

Zanzibar

An estimated 95% of fisheries on Zanzibar, most of which occur in the coastal environment comprised of coral reefs, mangrove creeks, sea grass beds and sand banks, are typically small-scale and artisanal in nature, comprising of around 34,000 fishermen using traditional vessels and gear to catch small- and large pelagic species, demersal species, octopus, squid and sea cucumbers (Jiddawi and Khatib 2007). The high marine resource-dependence of coastal communities on Zanzibar is based not only on a subsistence economy, but is also driven by rapidly growing international tourism and trade. There is a market for almost all functional fish groups, large and small, leaving no refuges within the accessible marine ecosystem for fish assemblages (Thyresson et al. 2013, D. Schaumlöffel *unpublished data*). Not only does this place the ecological system under constant stress by the demands of local and non-local resource users, but it deepens the level of marine resource-dependency of coastal communities by encouraging investment in “more efficient” fishing technology. This acute situation promises little for the degrading marine ecosystem and entrenches social and ecological vulnerability to shocks and trends within the CM-SES as a whole.

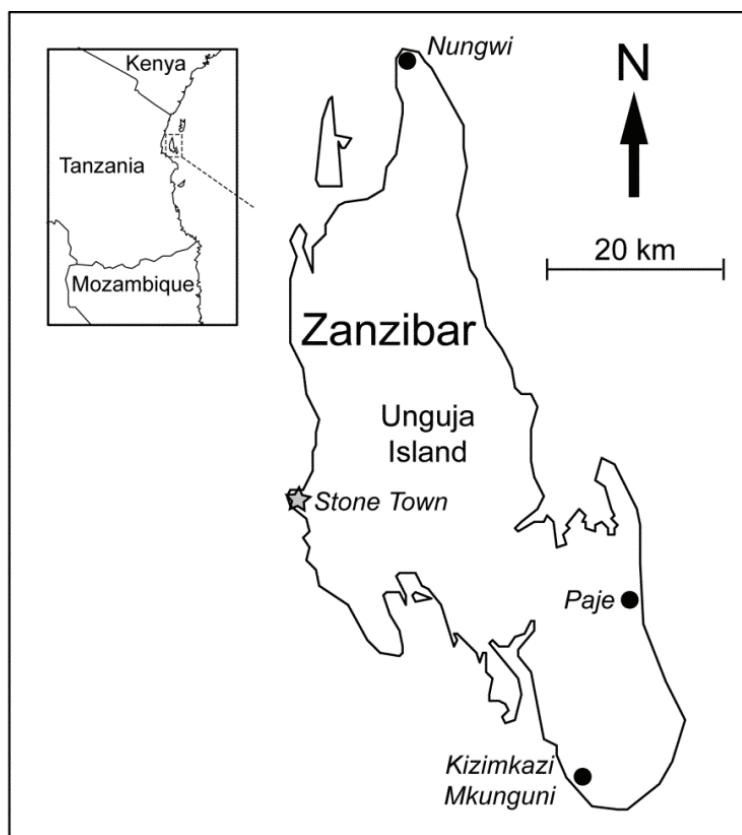


Figure 2 Location of research sites on Zanzibar

Indonesia

In Indonesia, the Spermonde Archipelago was selected as a research site in order to continue the ongoing work under the project ‘Science for the Protection of Indonesian Coastal Marine Ecosystems’ (SPICE III). This research forms part of Topic 1: ‘Marine biodiversity, food security and sustainability’, under Sub-project 6: ‘Coastal livelihoods and food security’. The Spermonde Archipelago exhibits serious levels of coral reef degradation as a result of anthropogenic effects. Land use change, pollution and the use of destructive fishing in general (Edinger et al. 1998; Chozin 2008) are driven by local and global demands for fish, sea cucumber and coral (Ferse et al. 2014). There is a market for most marine products. When considered in the context of growing human population on these small islands, integration of fisher folk into ever-expanding markets and development of fishing technologies brought to the archipelago through the patron-client networks means that the demands placed on an already over-burdened and highly vulnerable ecosystem will continue to increase.

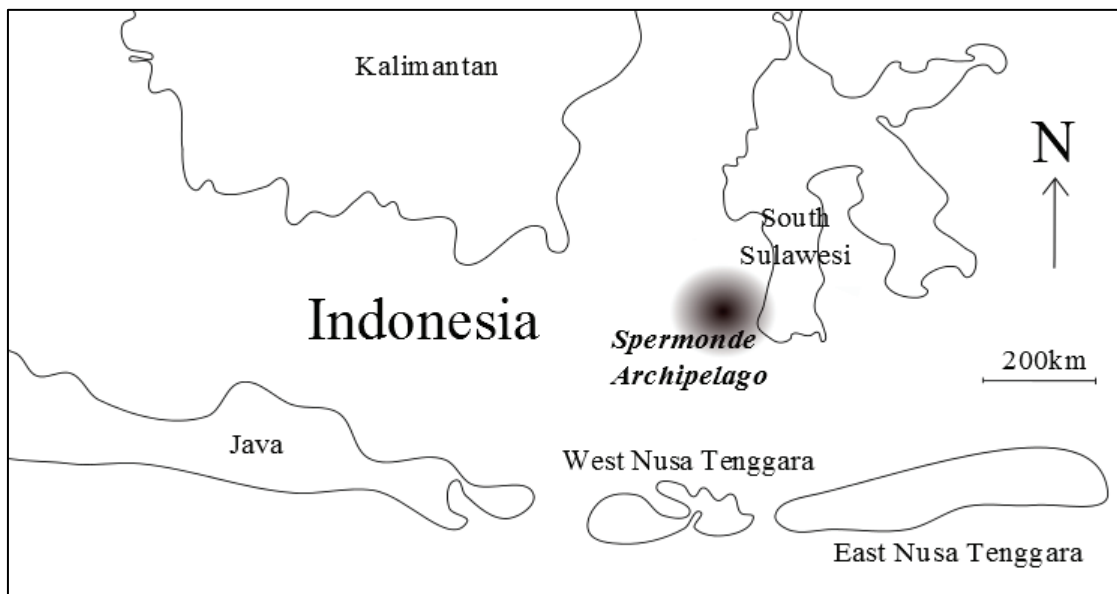


Figure 3 Location of research site in Indonesia

Chapter 1: Sustainable Livelihoods Approach in tropical coastal and marine social-ecological systems: a review

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Abstract: Tropical coastal and marine social-ecological systems (CM-SES) differ from other social-ecological systems through the higher degree of risk and uncertainty associated with coastal and marine resource extraction, the dynamic nature of aquatic and human resources, and often unclear tenure. CM-SES resource management and poverty-alleviation strategies must be adaptive and holistic. The Sustainable Livelihoods Approach (SLA) provides a framework for understanding and guiding policy-making in CM-SES. Case studies from the past 10 years analyse tropical coastal and marine-resource dependent livelihoods and/or to evaluate current CM-SES management using the SLA. These studies have shown that, despite the rounded and inclusive approach of projects such as the Sustainable Fisheries Livelihoods Programme, key challenges for researchers and practitioners remain including rights and access allocation, corruption, lack of local financial, intellectual and innovative capacity and centralized governance. Whilst the SLA may increase understanding of local-level dynamics within CM-SES, more consultation at interdisciplinary frontiers is needed in order to formulate practical solutions to the core problems of tropical CM-SES management.

Keywords: Sustainable Livelihoods Approach, SFLP, social-ecological systems, natural resource management, small-scale fisheries, poverty alleviation

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Introduction

Tropical coastal and marine systems are highly productive and biodiverse, home to around a third of all fish species described (Moberg and Rönnbäck 2003) and encompassing habitats ranging from coral reefs over mangroves and seagrass beds to sandy marine and estuarine environments. The complex and diverse nature of these environments encourages speciation and niche diversification, hosting biological memory for regeneration in the aftermath of change. Human populations in coastal areas are increasing as a result of migration, development and globalisation (Curran et al. 2002; Cinner et al. 2011; Small et al. 2012). Coastal and marine environments across the world are being severely degraded by a mosaic of anthropogenic effects (United Nations General Assembly 2011), ranging from overexploitation, eutrophication and pollution to habitat destruction and climate change. These processes undermine the quality and quantity of ecological goods and services provided to humans by impairing functions (Folke 2006) at the local, national and international scale. The most prominent example of human dependence on coastal and marine ecosystems is that of subsistence fishing. Dependence on subsistence fishing for an efficient and high quality source of protein and income is still high, especially in Africa, Asia and Latin America (Bell et al. 2009). Around 250m people depend on coral reefs alone for their livelihoods and sustenance (United Nations General Assembly 2011), meaning the decline of these goods and services presents a frightening prospect for coastal livelihoods across the globe.

For the purposes of this paper, a social-ecological system (SES) is defined as “a bio-geophysical system with its associated social agents and institutions in a problem context” [8:199]. The combination of marine and coastal natural resources and the social and economic realms that operate and change around these resources together comprise a coastal and marine social-ecological system (CM-SES) (Glaser et al. 2012a).

The greater the linkage between human livelihoods and natural resources (in both spatial and temporal terms), the more incentive resource users and policy-makers are expected to have to maintain ecosystem integrity and productivity (Salafsky and Wollenberg 2000). Livelihoods and the management of natural resources must be adaptable to ecological and social system fluctuations in order to be resilient and sustainable (Allison and Horemans 2006) and this is no different in a CM-SES. The complexity of CM-SES can impede management schemes, undermining sustainable environmental conservation and poverty alleviation (Christie 2004; Mahon et al. 2008; Aswani 2011). Resource management mechanisms in CM-SES, whether formal or informal, have significant effects on livelihoods in coastal areas (Salafsky and Wollenberg 2000; Adams et al. 2011). Studies suggest that there is scope for enhancing livelihood security but a more holistic analysis of coastal livelihoods is necessary in order to effectively manage the CM-SES for sustainability and resilience in the face of global change (Department for International Development 1999).

Using studies in coastal and marine resource-rich tropical regions, the usefulness of the Sustainable Livelihoods Approach for coastal livelihood analysis are examined, ultimately providing a context-specific appreciation of dynamic social-ecological vulnerability. Finally conclusions are drawn as to what challenges to definitive, positive change in terms of resource management in CM-SES remain. This review is being written 12 years after Allison and Ellis (Allison and Ellis 2001) paper on utilization of livelihoods approaches in fisheries management and 7 years after Allison and Horemans' (Allison and Horemans 2006) article on the use of SLA principles in fisheries development policy and practice. Embracing this approach with renewed awareness will allow for further discussion on how to ensure that the thereby-generated knowledge translates into action. Decision-makers are thus enabled

to develop more competent and locally-accepted resource management tools that can enhance the resilience of the CM-SES whilst empowering communities to increase their capacity for poverty alleviation.

What makes a CM-SES unique?

Both tropical coastal and marine and terrestrial realms are highly productive and biodiverse, and in both cases human communities are dependent on the natural resources available to them (Perry 1995; Folke et al. 2004; Glaeser et al. 2009; Ostrom 2009; Perry and Ommen 2010; Hughes et al. 2012b). Yet in the application of an SES framework, it is important to recognize that a CM-SES displays certain characteristics that distinguish it from a terrestrial SES and that these differences may impact upon both research imperatives/directions and management options.

Table 1.1 The distinguishing characteristics of tropical CM-SES (adapted from (Béné 2006; Glaeser and Glaser 2010; Glaser et al. 2010b; Cinner 2011; Glaser et al. 2012a))

Breakdown of CM-SES	Distinguishing characteristic of tropical coastal & marine SES
Bio-geophysical unit	<ul style="list-style-type: none"> • Resources are harder to locate and effects are more difficult to see • Migration of resource exhibits wide spatial and temporal variation • Natural disasters frequent, sudden and destructive
Social actors	<ul style="list-style-type: none"> • Large ethno-linguistic diversity due to higher levels of migration • High levels of poverty and stakeholder conflict
Institutions	<ul style="list-style-type: none"> • Systems of ownership and entitlements often unclear as territories are harder to define

In a CM-SES, boundaries between the ecological and social-political territories are harder to define. Coastal and marine social-ecological systems are far more variable in their resource base due to the movement of water, migration of species and the mobile nature of resource users (Dietz et al. 2003). In addition, the open-access regime that operates in most marine fisheries means that in order to gain more from a declining resource, users are incentivized to use more 'efficient' methods that ensure a greater catch per unit effort. These methods can be destructive to the ecosystem and deplete resources at an accelerated rate, further spiralling fisheries systems into degradation and vulnerability (Jiddawi and Öhman 2002), potentially landing the system in a social-ecological trap (Cinner 2011).

Contrary to the situation of many terrestrial systems, ownership of coastal and marine natural resources is often complex and ill-defined, with governments, private sector, the local community or no-one contesting entitlements. Lack of clarity in resource tenure (Bruce 1998) can mean a lack of rights, access and responsibility for resource users to manage CM-SES effectively and sustainably (Schlager and Ostrom 2008; Mascia and Claus 2009; Petrosillo et al. 2013) leading to conflicts over entitlements between claimants, authorized users, owners and proprietors. As a consequence, effective resource management remains a far-fetched goal where ownership and use of natural resources cannot be allocated with recognized legitimacy.

A combination of the above factors means that a CM-SES is subject to a greater level of risk and uncertainty in comparison to its terrestrial counterpart. As a result, coastal community livelihoods are more vulnerable to change, instability and dysfunction (Tundi et al. 2005). Fishery-based livelihoods in general are exposed to different risks and uncertainties in comparison with agricultural livelihoods, providing greater incentives for collective action, cooperation (Perry 1995) and involvement in shared-contract arrangements such as patron-client systems (Platteau and Nugent 1992). Yet social, economic and political factors have shown to undermine rather than support bottom-up management strategies even where enough biological data and motivation exists (Christie 2004; Aldon et al. 2011). The risk and uncertainty that comes from being directly reliant upon coastal natural resources stems from the lack of predictability and/or control of externalities to the system. Livelihoods based on coastal and marine natural resources are susceptible to risk and uncertainty in the form of natural and social trends and shocks, meaning that total reliance on these resources leaves many coastal communities in an exceptionally vulnerable state. Andersson and Ngazi postulated that in the case of fishermen, individuals “are exposed to high degrees of risk and uncertainty in terms of personal safety as well as income” [37:688]. Béné et al., (Béné et al. 2000) found that heavy dependence on natural resources led to a greater impact on community well-being in the face of environmental change. Bearing this in mind, it is important to recognize a CM-SES as a particularly sensitive and unique system when attempting to conduct any kind of analysis aimed at effective resource management (Glaeser and Glaser 2010; Aswani 2011).

SLA as a holistic and context-relevant tool for understanding a CM-SES

The Sustainable Livelihoods Framework is heralded as a holistic conceptual framework for understanding community livelihoods (Campbell 2008), with a particular capacity for addressing poverty-alleviation through livelihood diversification. The SLA considers all aspects of poverty and wealth simultaneously. It asks not just how many people are poor, but why? And it paints a more complete picture of why ecosystems become overexploited and degraded and what such degradation can mean for their dependent human communities (Pittaluga et al. 2004).

In terms of tropical CM-SES, Glavovic and Boonzaier (Glavovic and Boonzaier 2007) argue that SLA complements integrated coastal management (ICM) in that it focuses sustainability on people, rather than ecosystems. The SLA emphasizes the capabilities and potentialities that exist within resource user communities and grants a necessary focus on social relations, government processes and institutions in contributing to livelihoods. Horemans wrote of the people-centred, participatory and dynamic nature of SLA, adding that the framework was “responsive”, “multi-level” and “holistic” [40: 232].

The SLA focuses on the vulnerability context in which resource users operate, the assets they possess, policies they are subject to and options and strategies available to them. Capabilities and assets (physical, financial, natural, social and human capital) are a function of the relevant enabling or hindering policies and outcomes of customary and formal institutions (Ellis 1998; Allison and Ellis 2001; Glavovic and Boonzaier 2007; Sharma 2010).

Case studies of SLA in CM-SES

Béné et al., (Béné et al. 2000) and Cinner et al., (Cinner et al. 2010) have shown that poorer households have a greater reliance on fishing as a primary subsistence activity or source of income. It remains unclear whether the poor turn to fishing because they lack alternatives, or whether over-exploitation of coastal and marine natural resources, due to population increase or coast-ward migration for example, leads to poverty in small-scale fisheries (Cinner et al. 2009c).

SLA has been used in CM-SES around the globe to identify which resource management systems are appropriate, and where and why existing management systems have failed. Ahmed et al. (Ahmed et al. 2010) found that a total ban on prawn post-larvae fishing in coastal Bangladesh was never fully enforced, given that communities were not provided with an alternative. As a result, the natural resource base continued to be eroded, thus posing a direct threat to human livelihoods and ecosystem viability within the CM-SES. The SLA analysis of post-larvae fisher livelihoods highlighted the need for livelihood diversification, combined with a 'food-for-work' approach already promoted by the national government to improve the productivity and value of existing post-larvae exploitation practices.

Other studies (Bunce et al. 2009; Kramer et al. 2009) found that physical isolation can restrict livelihood options and increase dependence on natural resources, especially for small island communities (FAO 2006; Pomeroy et al. 2006). Yet the ability to diversify livelihoods depends greatly on the capital assets of resource users as well as their perceived assets and social embeddedness (Ellis 1998). In the Philippines, Salayo et al (Salayo et al. 2012) showed how government schemes on livelihood diversification to mariculture have the potential to generate economic returns for fishers and their households whilst also generating employment in coastal communities. However, the study identified that the slow progress made by the government scheme meant that, although fish food supply had increased, there was a reduction or delay in economic benefits to small-scale fishers. Most of the aquaculture enterprises were owned by existing business owners who possessed the necessary capital to engage in mariculture. Although mariculture itself was not disregarded as a viable livelihood diversification option, the intended benefits of the policy and practice were shown not to reach the target population.

Possibly the largest and most well-known project to use SLA in CM-SES is the joint United Nations FAO and DFID Sustainable Fisheries Livelihoods Programme (SFLP) in the West African Region (Allison and Horemans 2006). The aim, focusing mainly on poverty-alleviation, is to strengthen "both resource management systems and the livelihood systems of fisher folk by promoting strategies for poverty alleviation that reinforce peoples' existing capabilities, are participatory and empowering, and take into account the limitations of resource renewability" (Food and Agriculture Organization (FAO)). Using the FAO Code of Conduct for Responsible Fishing and the SLA framework within SFLP, practitioners have addressed economic, social and environmental needs in Senegal (Failler and Kane 2004), Côte d'Ivoire (Satia et al. 2004) and 23 other countries in Central and West Africa (Horemans 2004). The results have included an identification of the gaps in fisheries and resource management policy and practice in Nigeria (FAO & DFID, 2002).

The SLA is not without its limitations. The most obvious weakness of any participatory social analysis is the reliance on good quality information (Morse et al. 2009). When dealing with concepts such as poverty, natural resource management and social capital, response bias to meet researcher or even respondent expectations may be unavoidable. In addition, the constructivist argument states that there are layers of reality and knowledge. Each actor perceives reality through his or her lens, leading to positional knowledge. Even where respondents are truthful, their inherent knowledge of local dynamics may not always match that of the next person, or of the researcher, leaving the researcher with a *perception* of local context.

The level of detail of an SLA can be a blessing but also a burden. For comparative analysis, the resolution of data may not be the same, causing one study to lose a degree of detail and accuracy. Should this loss be significant, the analysis itself may become obsolete as any generalizations drawn

are not applicable to heterogeneous communities (Morse et al. 2009). Moreover, how does one ensure representativeness in a heterogeneous community? The pool of potential respondents is likely to be constrained by the cost- and labour-intensity of SLA, meaning that only a snapshot of the overall population can be surveyed. Even where it is recognized that SLAs are contextual and case-specific, human dynamics and relationships are not so easily categorized as to inform wholly applicable broad-spectrum policies on resource management. A more detailed evaluation of the SLA framework can be found in Allison & Horemans (Allison and Horemans 2006) and Morse et al. (Morse et al. 2009).

These limitations do not however undermine the value of holistic approaches to interventions in CM-SES. If anything, they lend support to the idea that CM-SES management must be “based on evidence and a sound understanding of constraints” [39:63]. The SLA remains a useful tool for bridging the gaps between policy and practice through participation of natural resource-dependent communities (Capistrano and Charles 2012).

Challenges to researchers working towards effective and fair management of CM-SES.

Given the context-specific nature of CM-SES and SLA analyses, there can be any number of issues that interact with and inhibit the effectiveness of CM-SES management. Studies conducted in small-scale fisheries, show a pattern of well-established obstacles and highlighting four main areas of concern that can be potentially problematic for researchers and practitioners working in tropical CM-SES.

Stakeholder conflict

Particularly in CM-SES, boundaries (associated with resources and land as well as political and social boundaries) and rights allocations are often, at best, blurred. The recognition of user and ownership rights is key to effective CM-SES resource management (Schlager and Ostrom 2008), especially for marginalized groups (Capistrano and Charles 2012). The challenge then lies in understanding, let alone regulating, what can and cannot be used by whom in what way. When aiming for sustainability, this lack of understanding and inability to exert control over a dynamic medium can not only make resource management a work of Sisyphus, it can fuel existing social conflicts, create new tensions and lead to even more unsustainable resource extraction (Myers 2002).

Corruption

Corruption is one obstacle that has been shown time and again to either impede or obstruct resource management in CM-SES (Cullen 2007; Glavovic and Boonzaier 2007; Reichel et al. 2009; Sundström 2012). Willingness to comply by local resource-users depends on the perceived corruptibility of enforcing authorities. Corruption can exist through bribery and lobbying as well as in the form of impeding actual implementation of CM-SES management regulations. Even small-scale bribery cannot be ignored if working towards effective CM-SES management and sustainability (Sundström 2012).

Lack of local capital assets and capacity

A high degree of dependence on dwindling and degrading coastal and marine natural resources can motivate communities, through a sense of crisis, to recognize the need for action towards sustainable management, conflict resolution and discussion (Andersson and Ngazi 1998; Salafsky and Wollenberg 2000). One of the key principles behind SLA is the gathering of knowledge in order to enable and encourage communities to become agents of their own development, potentially through cooperation and collective action. Yet community-based institutions often lack the local capacity or recognized authority to formulate and implement resource use regulations (Ferse et al. 2010). Meanwhile central

governing bodies can move slowly and in the case of developing countries, often too lack the finances and resources to support local resource management and poverty-alleviation initiatives (Wever et al. 2012).

Weak institutional structures

To manage a CM-SES in an effective and efficient way, rules and organizations must be allowed to evolve around the changing circumstances and multiple sources of knowledge and ideas that characterize CM-SES – an adaptive management approach (Walker et al. 2002; Dietz et al. 2003; Olsson et al. 2004; Plummer and Armitage 2007; Nelson et al. 2007; Moffat et al. 2011). In resource-rich, poverty-stricken areas, the necessary funds and know-how to manage resources with such flexibility is often lacking, leaving researchers and practitioners with a dilemma: the key to sustainable livelihoods is adaptive management, but local capacity for implementation is low and governments and funding bodies are seldom keen to release power or money into holistic, long-term projects that have an uncertain future (Horemans 2004).

Since Allison and Horemans' (Allison and Horemans 2006) article on the SLA and SFLP, numerous studies have shown that the true benefits of these projects are still not permeating all the way down to the local level. Rather than being a tool for CM-SES management, the SLA often ends up highlighting where current strategies are failing. Whilst useful, this does mean that the questions of rights and access, corruption and low capacity and weak governance remain unsolved.

Conclusions

The higher degree of uncertainty and diversity of tropical CM-SES means that resource management and poverty-alleviation strategies in these inherently complex systems require an adaptive, context-relevant and holistic approach. The Sustainable Livelihoods Approach is an analytical tool used in many regions for guiding policy-making in CM-SES. The case studies in this paper show how the SLA is used across tropical regions to gain appreciation of coastal and marine-resource dependent livelihoods and/or to evaluate current CM-SES management strategies. The lessons from such studies have shown that, despite the admirably ambitious approach of projects such as the Sustainable Fisheries Livelihoods Programme, familiar challenges for researchers and practitioners remain: including stakeholder conflict, corruption, lack of local capital assets and capacity and weak governance structures and approaches. Whilst the SLA may improve understanding of local-level dynamics within CM-SES, more work is needed to address these recurring obstacles to natural resource governance and poverty-alleviation schemes in tropical developing nations.

Perhaps it would be prudent for researchers and practitioners to adopt the rhetoric of 'learning to accept the things they cannot change', more recently surmised in the context of resilience management as "learning to live within systems rather than control them" (Walker et al. 2002). In tropical CM-SES it is sometimes feasible to address stakeholder conflicts, corruption, low capital assets and capacity and weak governance at the local level, but this is dependent on many factors such as project funding, design and timeline, motivated staff and of course local perceptions of empowerment and values. Yet it must be acknowledged that the influential factors operating at higher scales (national government, international trade, climate change etc.), are often far beyond the control of local actors and project staff. As far as possible then, it is advisable and indeed necessary, to develop a self-sustaining approach to CM-SES management that is able to continue to learn, adapt and change independently.

Table 1.2 Factors that undermine CM-SES management

Stakeholder conflict	Corruption	Lack of local capital assets & capacity	Weak institutional structure
No recognition of access, user rights and traditional management in India (Sekhar 2004).	Corruptibility of authorities undermines willingness to comply with fisheries regulations (Sundström 2012).	Low social cohesion and asset inequalities undermine environmental governance in Zanzibar (Myers 2002).	Poorly defined legal structures, apartheid legacy and low enabling environment for sustainable coastal livelihoods in South Africa (Glavovic and Boonzaier 2007).
Conflicts between socio-political and ethno-linguistic groups over resource scarcity in Indonesia (Reichel et al. 2009).	Missing funds for Segara Anakan Conservation and Development project in Indonesia. No means of reporting contestation by stakeholders (Reichel et al. 2009).	Lack of skill, labour and/or capital prevents livelihood diversification for risk management in East Africa (Eriksen et al. 2005).	Incomplete decentralization of coastal zone management in Indonesia (Siry 2006).
Capture limitations to local elites reinforced local poverty structures in Cameroon and Nicaragua (Bastiaensen et al. 2005).	“Protection insurance networks” enable unsustainable fishing in Sulawesi, Indonesia (Radjawali 2011).	Low perceptions of capital assets reduces SES system recovery after natural disaster on Rodrigues Island (Bunce et al. 2009).	National policies on decentralization, participation and democratization not yet properly implemented in local coastal management in Brazil and Indonesia (Wever et al. 2012).
Tourism interests take control of MPA management in the Philippines (Christie and White 2007a).	Corruption amongst authorities reduces enforcement of MPA regulations in Zanzibar (Tobey and Torell 2006).	Lack of alternative livelihoods means natural resource management schemes not firmly enforced in Bangladesh (Ahmed et al. 2010).	Failure to include local stakeholders in MPA design and implementation leads to socio-economic shortcomings (Ferse et al. 2010).
Resource competition between stakeholders undermines MPA compliance in Zanzibar (Tobey and Torell 2006).	Low political transparency negatively impacts upon management effectiveness of fisheries (Mora et al. 2009).	Market access, migration and technology impact upon household asset bases and social networks (Kramer et al. 2009).	Colonialism, short-termism, ill-defined geopolitical boundaries and mismatches in institutional jurisdictions hinder fisheries management in the Philippines (Christie et al. 2007).

The road to effective, just and sustainable CM-SES management is long and arduous. Much progress has been made since SES gained a foothold on the stage of ecosystem management (Glaser 2006) but the limits of knowledge and practice have not yet been reached. Integrated, multi-disciplinary knowledge for CM-SES analysis and management is now moving beyond infancy, addressing mismatches of scales, complexity and context-specific realities (Glaser et al. 2012b). In doing so, researchers and practitioners have been blurring the boundaries between conservation, development, poverty-alleviation and natural resource/ecosystem management. Pushing against these frontiers through deepened interdisciplinarity, consultation and reflection is vital to the ongoing development of successful CM-SES management.

Chapter 2: Patron-client relationships, livelihoods and natural resource management in tropical coastal communities

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Abstract: Coastal and marine management cannot ignore the role of community livelihoods and vulnerability if it is to be effective and just, especially when the targeted coastal communities are highly resource-dependent. Previous studies have highlighted the potential role that patrons, or middlemen, can play as knowledge-brokers in marine natural resource management. On Zanzibar, where small-scale fishing is an important livelihood for many coastal communities, patron-client systems operate without regulation. This study investigates the roles patrons play regarding coastal livelihood vulnerability and natural resource management. It asks not only what patron-client relationships as institutions contribute to fishing households within the framework of the Sustainable Livelihoods Approach, but how these contributions differ across coastal villages. Furthermore, what do patron-client relationships mean for coastal livelihood vulnerability as well as marine natural resource management? Data was collected from 3 villages on Zanzibar with questionnaires, semi-structured key informant interviews, focus groups and participant observations. Although patrons have been identified in this and previous studies to be drivers of resource exploitation, they are also potential agents in identifying and activating sustainable solutions to environmental decline and improving fishing household resilience. Our results confirm previous findings that the role of patrons is mainly in providing fishing equipment and short-term relief in times of hardship, either through food or money. Our findings also show that there are small but significant differences in the type of contributions patrons make to coastal households.

Keywords: Coastal communities, livelihoods; marine conservation; natural resource management, patron-client; Zanzibar

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Introduction

Patron-client relationships have existed since ancient Roman times (Pelras 2000) and have been described as “dyadic contracts [...] based on the principle of, and [...] validated by, reciprocal obligations expressed in the exchange of services” (Foster 1963). The defining characteristic of a patron-client relationship is the asymmetry that exists between the two actors, who are of “significantly different socioeconomic status” (Foster 1963). Another feature is the multifaceted, or multi-stranded character of the patron-client relationship, which stands in contrast to single issue relations such as for employment, credit or trade (Ferse et al. 2014). Coastal communities in the Western Indian Ocean are vulnerable to sudden shocks and long-term trends through their exposure, sensitivity and degree of adaptive capacity (McClanahan and Cinner 2012). Patron-client relationships in these communities have profound implications for fishing household livelihood security and their vulnerability by providing economic income through fishing or fish trading and social security in times of hardship, and by contributing flexible and potentially exploitative credit-debt systems (Platteau and Nugent 1992). The flow of benefits in patron-client relationships has been mapped across many regions in the literature in order to identify the roles fulfilled by each actor and how such relationships can exacerbate or mitigate vulnerability, and influence coastal livelihoods more generally (Béné 2006). For an overview of some of the benefits that flow between patrons and clients see Table 2.1.

The role of patron-client relationships in contributing to or mitigating fishing household vulnerability and the conditions under which such exchanges occur is often overlooked. Poverty (Béné 2006), weak governance, marginalization, lack of social, financial and legal security and poor national integration of fisher folk (Sandbrook 1972; Lowe 2000; Wood 2003; Wolf 2004) not only allow patron-client relationships to prevail, but contribute to some of the distinguishing attributes of these asymmetric relationships: debt & kinship (Acciaoli 2000) and mutual dependency (Stein 1984) across multiple levels. Patron-client relationships are often an integral and even central part of fishing households’ livelihood strategies. The question then becomes whether these relationships contribute towards household livelihood sustainability by providing clients with access to otherwise unobtainable assets and opportunities, or whether conversely they entrap clients in a self-perpetuating system of dependence, poverty and debt, further entrenching them in a state of vulnerability. The literature is ambiguous on this. Several analyses (see Table 2.1) emphasize the provisioning function of the patron-client relation, while others tend to view this relationship as purely exploitative. Efforts to mitigate vulnerability and to manage natural resources sustainably need to take into account the importance of these relationships as a form of ‘coping strategy’ (Ferse et al. 2014) for those who depend on marine resources.

Zanzibar and patron client relationships

Small-scale artisanal fishing is an important livelihood along the coast of East Africa: an estimated 95% of fisheries on Zanzibar are of this nature and provide income to an estimated 34,000 fishermen (Jiddawi and Khatib 2007). On Zanzibar, small scale fishermen work in coral reefs, mangrove creeks, sea grass beds and sand banks using traditional gears and vessels (Crona et al. 2010; Richmond 2011). Middlemen, defined as “intermediaries in direct contact with fishermen at the landing sites, and often commissioned as agents for larger collectors” (Crona et al. 2010), can be found in most fishing communities on Zanzibar acting as key ‘knowledge-brokers’ for natural resource management.

Crona et al. (2010) postulate that reciprocal agreements and credit arrangements in South Kenya and Zanzibar mirror those in small-scale fisheries in other parts of the world (Crona et al. 2010).

Middlemen channel market demands from end-buyers to fishermen and provide credit as a short-term buffer against seasonal and other types of income lows throughout the year. Patronage in fisheries lacks formal institutional organization or regulation on Zanzibar but in the context of technological improvements links the constant demand for fish to a dependent and willing workforce that engages in unsustainable fisheries.

Table 2.1 Flows of benefits between patrons and clients in fishing communities. This list is not exhaustive.

Benefit for client (fisher)	Reference(s)	Benefit for patron	Reference(s)
Credit for subsistence and capital for investment	(Platteau 1989; Rahman and Wahid 1992; Acciaoli 2000; Pelras 2000; Wood 2003; Wolf 2004; Crona et al. 2010; Ruddle 2011; Sudarmono et al. 2012; Eriksson et al. 2012)	Loyalty	(Galt 1974; Acciaoli 2000; Lowe 2000; Wolf 2004; Eriksson et al. 2012)
Flexible loans	(Ruddle 2011)	Labour	(Acciaoli 2000; Pelras 2000; Ruddle 2011; Sudarmono et al. 2012)
Security during hardship	(Foster 1963; Stein 1984; Acciaoli 2000; Pelras 2000; Ferse et al. 2014)	Social prestige	(Pelras 2000)
Equipment such as gears or boats	(Acciaoli 2000; Ferse et al. 2014)	Information on competitors/enemies	(Sandbrook 1972; Wolf 2004)
Legal protection	(Sandbrook 1972; Pelras 2000; Wolf 2004; Radjawali 2011; Sudarmono et al. 2012)	Political support	(Sandbrook 1972)
Access to markets	(Lowe 2000; Wood 2003; Radjawali 2011; Sudarmono et al. 2012; Ferse et al. 2012; Ferse et al. 2014)	Produce at low prices	(Lowe 2000; Deswandi 2012; Ferse et al. 2012)
Personal support e.g. advice and match-making	(Pelras 2000; Ruddle 2011; Sudarmono et al. 2012)		
Access to resources	(Rahman and Wahid 1992; Wood 2003)		
Access to information	(Stein 1984; Wood 2003; Crona et al. 2010; Ferse et al. 2014)		

No doubt the role of patron-client relationships is important in small-scale artisanal fisheries in tropical countries with large sections of the population in insecure and poor conditions. There should be a focus on how middlemen can help “nurture the sustainability and resilience of coastal social-ecological systems” (Crona et al. 2010). However coastal and marine social-ecological systems are inherently complex and varied (Glaser et al. 2009; Glaser et al. 2012a), and so we must ask whether this broad analysis is truly representative of patron-client systems across Zanzibar, let alone across the tropics. We ask three questions: firstly, what are the benefits that flow within this dyadic relationship? Secondly, in which parts within the SLA pentagon do patrons have the most influence on small-scale fishing households? And finally, how important are patron-client relationships in determining the livelihoods of these households?

Our aim here is to highlight that differences exist in the degree to which fishermen depend on patrons across Zanzibar and thus to accentuate the general findings of Crona et al. (2010) that patrons (or middlemen) have an important role to play in natural resource management and mitigation of vulnerability in coastal communities.

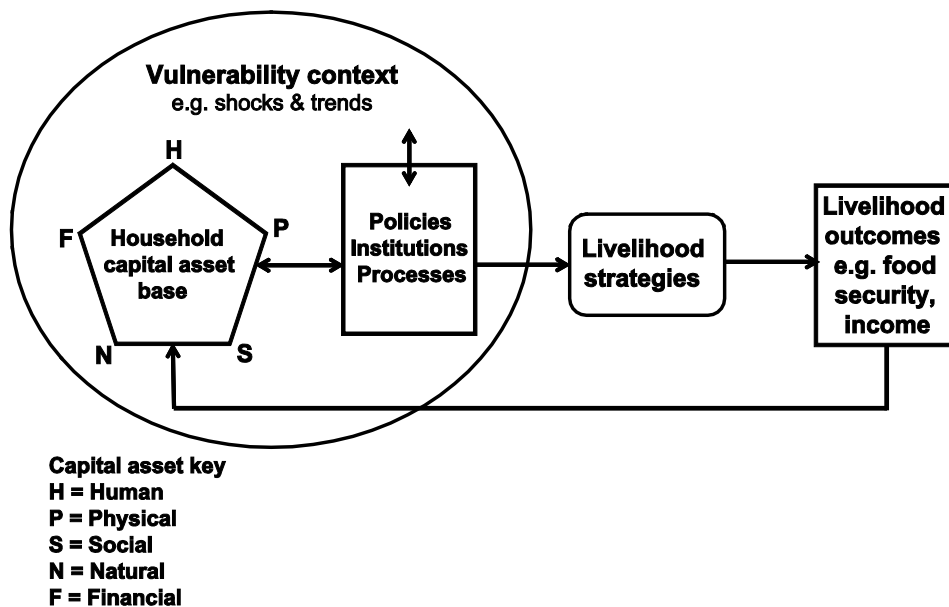


Figure 2.1 The Sustainable Livelihoods Approach showing the household assets and policies, institutions and processes components as existing together in the vulnerability context, all of which define livelihood strategies to achieve specific livelihood outcomes (modified from the Department for International Development, UK, 1999)

Using a case study approach, this paper analyses the flow of benefits between patrons and clients to bring to light the role that these relationships play in contributing to small-scale fishing household livelihoods by identifying which household livelihood assets of the SLA pentagon patron-client relationships affect and how. Although patrons may influence targets species choice in small-scale fisheries through market access and provision of specialized fishing gear (Schwerdtner Máñez and Ferse 2010; Ferse et al. 2012; Ferse et al. 2014), in Zanzibar, the developing local infrastructure and tourism means that there is a market for almost any type of catch (Thyresson et al. 2013). Therefore the dynamics of patron-client relationship with regards to fishing household vulnerability are the focus of this research, rather than the specific natural resources targeted.

Methods

Sustainable Livelihoods Approach and coastal governance

A comprehensive tool for analysing vulnerability in small-scale marine fisheries is the Sustainable Livelihoods Approach (SLA) (Department for International Development 1999; Allison and Ellis 2001). The SLA evaluates livelihoods on the basis of wealth and assets, as well as surrounding contexts, in order to obtain a picture of the capacity within households to mitigate vulnerability, even in the face of sudden shocks or long-term trends (Fig.2.1) (Allison and Ellis 2001; Pittaluga et al. 2004). For more information on the SLA see (Allison and Ellis 2001; Allison and Horemans 2006; Morse et al. 2009; Ferrol-Schulte et al. 2013). Patron-client relationships fit into the SLA in the context of small-scale marine fisheries as an institution that can profoundly influence the livelihood asset base of a fishing household – also known as the livelihoods pentagon.

The SLA is a useful tool to analyse coastal- and marine-resource dependent livelihoods in small-scale fisheries contexts (Allison and Ellis 2001). A comprehensive and inclusive understanding of livelihoods, and the roles individual actors play in influencing those livelihoods, can better inform coastal governance by redirecting management efforts towards strategies and fisheries policies that are more holistic and effective for natural resource management, conservation and poverty alleviation (Allison and Ellis 2001; Allison and Horemans 2006; Ferrol-Schulte et al. 2013). Focusing on patron-client systems in a small-scale fisheries context allows us to bring forward an important stakeholder dynamic that is often overlooked in fisheries management and policy. Indeed, on Zanzibar, many management strategies, policies and even punitive measures regard fishermen as the masters of their own destiny, whilst the impact and demands of patrons upon a fisherman’s opportunities and decision-making are left unaccounted for (Thyresson et al. 2013). Our research aims to unravel the dynamic between patrons and client in order to guide coastal governance in small-scale fisheries into more comprehensive, equitable and effective directions.

Sampling strategy

Surveying was conducted in three locations in the North, East and South of Unguja Island (Zanzibar), representing coastal communities with a high degree of marine resource dependency and with various degrees of tourism development. No sites were selected from the western side of the island in order to exclude the influence of terrestrial livelihood variability on patron-client relationships.. Data was collected from Kizimkazi Mkunguni, Paje and Nungwi (Fig.2), from April until July 2012 during the south-west monsoon period. A breakdown of sites and sample sizes by method is provided in Table 2.2. Respondents were selected using opportunity sampling at fish landing sites as fishermen were returning to shore.

Table 2.2 Breakdown of sites and sample sizes

Method	Kizimkazi Mkunguni	Paje	Nungwi
Questionnaire <i>fishermen</i>	75	75	75
KII <i>Village chairman (sheha)</i>	-	1	1
KII <i>Chairman fishing committee</i>	1	1	1
KII <i>Beach recorder (bwana diko)</i>	1	1	1
KII <i>Middleman</i>	2	1	1
Focus group <i>women</i>	1	2	1
Focus group <i>cooperative leaders</i>	-	1	-

Survey Technique

Three techniques were used in order to triangulate data and information from multiple sources. Questionnaires were carried out with fishermen at landing sites. Key informants, with whom semi-structured interviews were conducted, were defined as patrons, local leaders or government officials. Focus groups either aimed at collecting data from age groups not represented by questionnaires or interviews, women, and representatives from fishing cooperatives, or centred on a specific topic of interest. The questionnaire was divided into sections according to the SLA framework, focusing mainly on the household asset base and livelihood strategies, although other components of the framework were also addressed (threat perception and conflict resolution). Policies, institutions and processes and vulnerability context data was gathered through secondary data collection, focus groups, and key informant interviews, although other components of the framework were occasionally discussed by the respondents. Focus groups and key informant interviews were semi-structured. All interviews were conducted in Swahili by the main author in the presence of a local guide.

Table 2.3 Benefits exchanged between patrons and clients and disadvantages perceived by client fishermen of engagement in and/or dependence on patron-client relationships

Benefit / Disadvantage (categories coded from responses)	Description
Fishing gear	Provision of nets, lines etc.
Employment	Patrons provide an easy means of employment if a fisherman has no qualifications or previous experience. One can receive ‘on-the-job’ training from other crew members.
Boat use	Provision of a dhow, engine, fuel etc.
Fish more intensively	By providing better boats and fishing equipment, fishermen can fish deeper and further offshore
Money	Small loans for fishing households for food, weddings, transport etc.
Social support	Contributions to household by food gifts, arranged marriages, networking.
Market access	Contacts in hotels and at the main market in Stone Town who purchase any catch, means of transporting catch via <i>dala dala</i> (small bus)
Low pay	Fishermen were being paid less than they deserved for their catch.
Uncertainty / danger	Perception that catches are “unpredictable” and that the sea is “dangerous”. *
Exploitation	Feeling that a patron is using fishermen for own personal gain at the expense of the fishermen’s wellbeing.
Conflict with patron	If a conflict with a patron arises, the fishermen will always lose the argument and possibly his job.
Equipment failure	When equipment or boats are broken, patrons are slow to repair or replace them meaning that fishermen cannot work.
Dependence on patron	Feeling at the mercy of a ‘boss’ and unable to defend oneself against a patron.

* These are perceived disadvantages of fishing overall, not just of fishing for a patron. This category, while not uniquely linked to involvement in a patron-client relationship, was often mentioned as being associated with fishing livelihoods. Given that many respondents had only engaged in fishing *because* they had a patron (as denoted by the category ‘employment’), this category remains an important factor for many fishermen when deciding whether to engage in such a relationship.

The questionnaires addressed the five livelihood assets (financial, human, natural, physical, social – see Fig. 2.1) of fishing households. Their engagement in and dependence on patron-client relationships was also surveyed with the benefits exchanged and perceived disadvantages of engagement in and/or dependence on patron-client relationships being the main focus. The categories assigned to the

benefits and disadvantages of patron-client relationships are described in Table 2.3. These were compared using a Chi-squared analysis.

A set of 10 'hardship scenarios' was created to represent each of the 5 parts of the SLA pentagon. For each hardship scenario, respondents were asked who they would first turn to for help. This was to capture the scenarios where patrons were used as a coping strategy during hardship. The nature of benefits associated with patron-client relationships found in the literature meant that more scenarios were created for financial, social and human assets. This allowed a differentiation between short-term coping strategies and long-term adaptations to natural and anthropogenic changes. Respondents who identified themselves as working with patrons were asked to describe the conditions of exchange, advantages and disadvantages of having a patron. For all respondents we gathered data on household livelihood diversification strategies categorized into: farming, paid employment, informal labour, gleaning, tourism and seaweed farming. For each respondent, information on fishing gear, target species, use of catch and fishing grounds was collected. Reported catches, fishing gear and vessels were used to categorize fishing activity into one of main 3 types: subsistence, local/small and tourist/large for each respondent

Statistical analysis

A Chi-squared test was used to determine whether there were significant differences between the 3 villages in dependence on patrons for each of the hardship scenarios (see Table 2.4). In order to generate a typology of scenarios (e.g., short-term coping strategies vs. long-term adaptation) for which patrons are relied on in each village, dendrograms were created using permutational cluster analysis to show the clustering, or similarity, of dependence on patrons in the various hardship scenarios. The clades indicate degrees of similarities in patron dependence for each hardship scenario within villages and illustrate differences in clades between villages. Chi-squared tests were also used to test for differences in respondent engagement in 3 types of fishery (subsistence, small/local or large/tourist/export) between villages. All statistical tests were run using STATA 11 software. Qualitative information gathered through focus groups, key informant interviews and participant observations was used to support and explain the questionnaire data.

A permutational cluster analysis was then used to create similarity dendrograms for each village. These show similarities in degree of patron dependence for each hardship scenario within villages and serve to illustrate differences in these clusters between villages. Chi-squared tests were also used to test for differences in respondent engagement in 3 types of fishery (subsistence, small/local or large/tourist/export) between villages. Qualitative information gathered through focus groups, key informant interviews and participant observations were used to support and explain the questionnaire data.

Results

Involvement in fishing networks

Of 225 fishermen interviewed, 134 (59.6%) were involved in patron-client relationships (see Fig. 2.2). More fishermen were involved in patron-client relationships than in cooperatives or working independently combined. The highest percentage involvement in patron-client relationships was in Nungwi.

Benefit exchanges in patron-client relationships

The benefits exchanged between patrons and clients were boats and/or nets for fish and/or money (Fig. 2.3). Sometimes, patrons would guarantee that any catch will be bought at a price determined by them (fishmongers). In all villages boats were provided more often than nets, and fishes were given directly to the patron more often than money from fish sales. A fishmonger was categorized differently to a patron who provided equipment in return for fish. There were significant differences between the three villages in the importance of boats ($\chi^2=93.321$, $p=0.000$), nets ($\chi^2=34.394$, $p=0.000$), fish ($\chi^2=16.545$, $p=0.002$) and fishmongering ($\chi^2=14.670$, $p=0.001$) in patron-client relationships. In Nungwi, of 66 fishermen engaged in patron-client relationships, 65 were provided with a boat, but only 17 with a net. The same pattern occurred in Kizimkazi Mkunguni, where 37 of 51 client fishermen received a boat and 14 a net. Paje was the only village where buying catch directly from fishermen (fishmongering) was the main benefit of having a patron for clients, rather than providing a vessel or equipment.

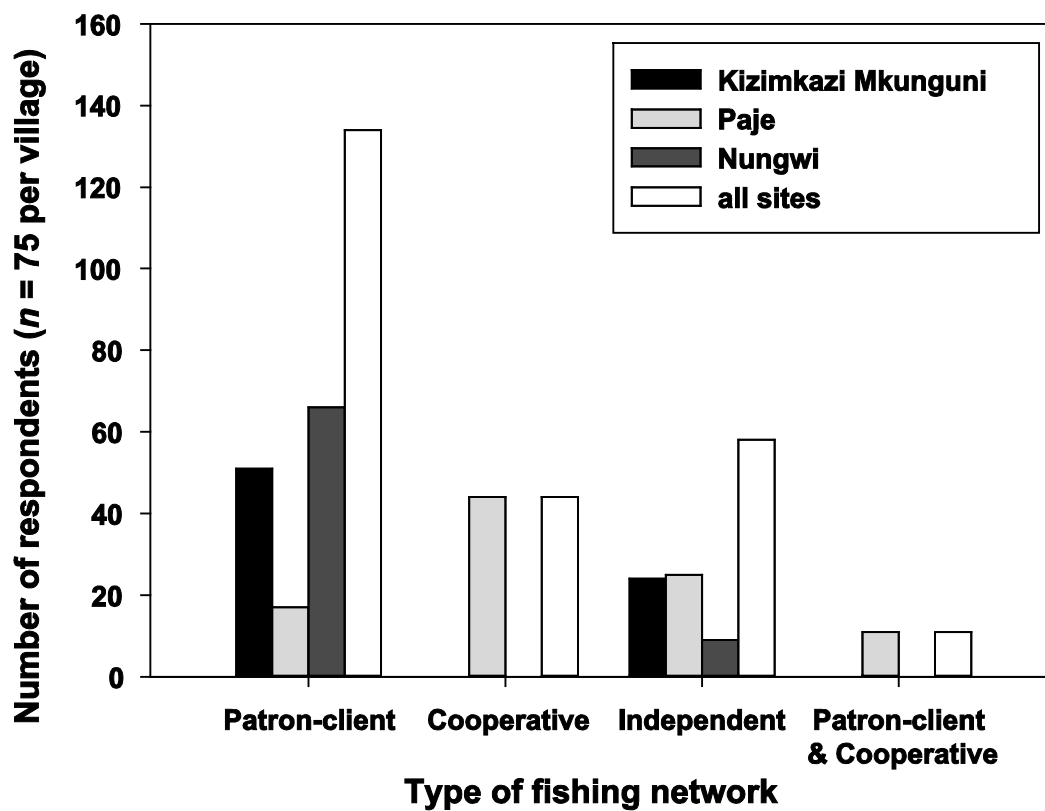


Figure 2.2 Number of fishermen respondents involved in patron-client and/or cooperative fishing networks in each research site

The most frequently perceived benefit in all villages of having a patron was ‘social support’ (62 of a total 134 clients. Chi-squared test between all villages; $\chi^2=11.533$, $p=0.003$). Other responses exhibiting significant differences between the villages were ‘employment’ ($\chi^2=23.074$, $p=0.000$), ‘being able to intensify fishing’ ($\chi^2=11.150$, $p=0.004$), and ‘none’ ($\chi^2=23.325$, $p=0.000$). For Kizimkazi Mkunguni, the second largest benefit to the clients was ‘boat use’ (8) followed by ‘being able to intensify fishing’ (7). In Nungwi, the second most frequent response was ‘employment’ (18) closely followed by ‘none’ (15). In both aforementioned villages, ‘access to market’ was negligible as perceived benefit (2 and 0 respectively). For Paje, ‘access to market’ and ‘none’ received the same low

count (2), probably because many fishermen claimed fishmongers (buying fish without providing any other benefit) to be their patron.

In all villages, most fishermen perceived no disadvantage to their involvement in a patron-client relationship. In Kizimkazi Mkunguni, 'low pay' and 'conflict with patron' were cited by 6 client fishermen as disadvantages to having a patron, yet 'exploitation' and 'dependence' received the lowest counts (1 out of 51). In Paje 'low pay' received the highest noted disadvantage to a patron-client relationship and was cited by 3 of 17 client fishermen. No respondents mentioned 'uncertainty/danger', 'equipment failure' or 'dependence'. In Nungwi however, 'equipment failure' had a similar frequency to 'none', with 17 of 66 client fishermen stating this as a disadvantage to having a patron. Fishing equipment failure was seen as a disadvantage when a patron (and in most cases owner of the fishing equipment), in the eyes of the client, took too long to repair or replace equipment, which meant that the fishermen could not work. 'Uncertainty/danger' was mentioned by 10 client fishermen.

Fishing methods

In all villages, nets and lines were the most common fishing method, more desirable than traps, spears or fishing by hand because they were the most efficient at targeting a wide range of species. In Kizimkazi Mkunguni and Paje, more lines than nets were used, in contrast to Nungwi (Fig. 2.4 & 2.5). Having a patron did not affect the distributions of usage of nets, lines and spears by fishermen in Paje. In Nungwi however, having a patron was significantly related to a fisher's use of nets ($\chi^2=8.82$, $p=0.003$). In Kizimkazi Mkunguni, the higher amount in usage of nets and lines by fishermen with patrons compared to independent/ cooperative fishermen was less prominent but still significant ($\chi^2=7.37$, $p=0.007$). Chi-squared tests indicated no significant differences in line-use between fishermen with and without a patron in any of the villages. The low frequency of usage of other techniques such as stick, hand, diving and hook however precluded statistical comparisons.

Patron-dependence in hardship scenarios

The most common hardship scenario in which a patron would be called upon for assistance (Fig. 2.6) across all villages was 'fishing equipment failure' (physical assets). 'Child wants to attend university' (human assets) presented the least frequent scenario for patron-dependency, with Nungwi showing zero dependency. Observation of 'illegal fishing' was removed from analysis as no respondent reported patron-dependence for enforcement of fisheries management strategies or involvement in illegal fishing activity.

Kizimkazi Mkunguni presented the most frequent reliance on patrons across all scenarios with the exception of 'fishing equipment failure', where the fishermen in Nungwi reported higher dependence. Table 2.4 shows that there was a significant difference in the frequencies of patron-dependence *between* villages for 8 of 9 scenarios with the exception being 'learn a new fishing technique'.

The dendrograms in Fig. 2.7-2.9 show relative distances (greater distance meaning less similarity) in frequencies between scenarios *within* villages, not between villages. The idea is to distinguish the relative importance of the different roles that patrons play within fishing household livelihoods for each village. Common themes within this analysis are the short- and long-term nature of scenarios where patrons may or may not play an important role for fishing households. In all villages, fishing equipment failure was by far the most common cited scenario when a fishing household would depend on a patron. In Kizimkazi Mkunguni (Fig 2.8) the frequency with which a fishing household would

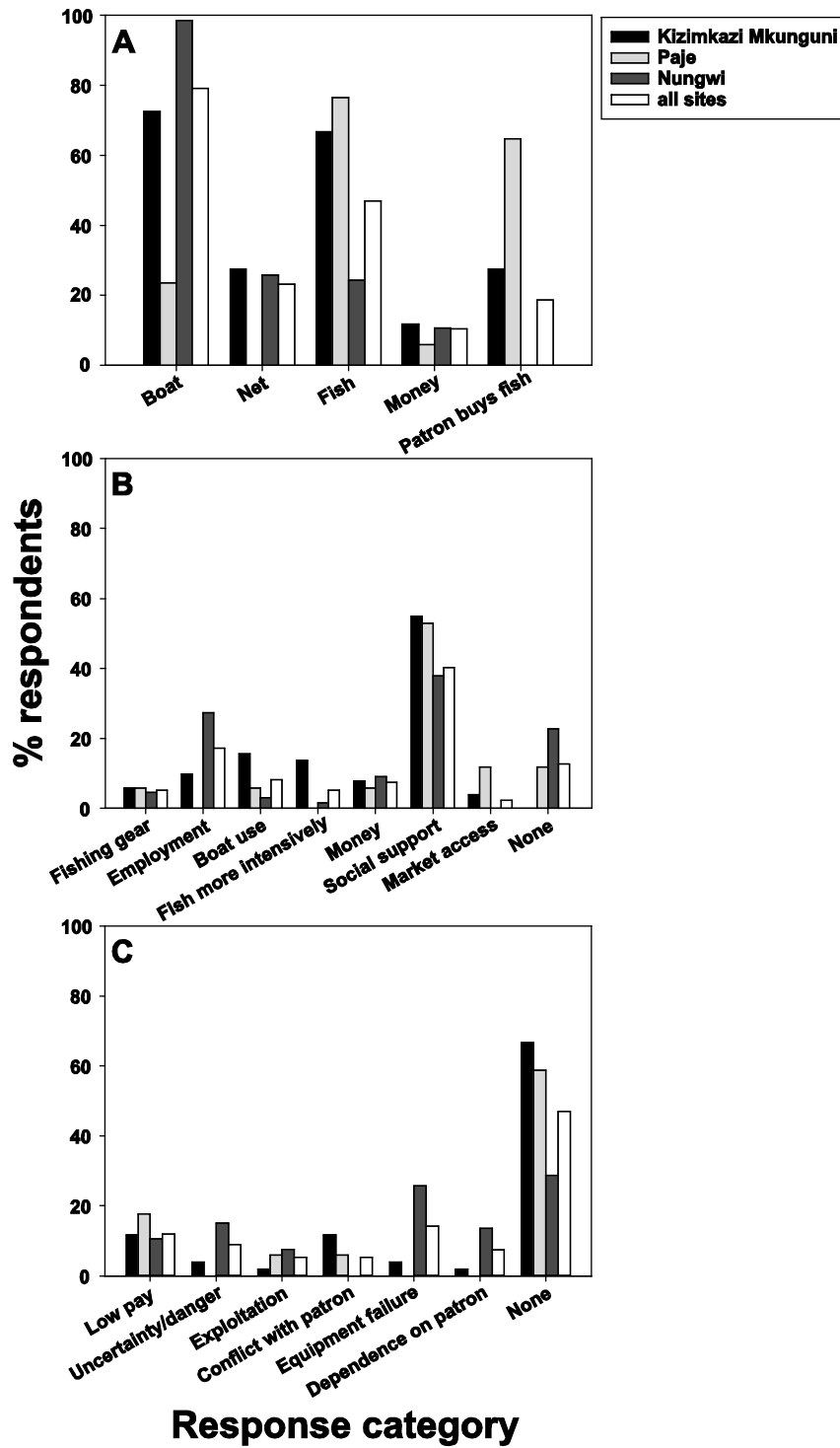


Figure 2.3 Benefits exchanged between fishermen respondents and patron (A; multiple answers possible. See text for more information), benefits of patron-client relationship perceived by fishermen (B), and disadvantages of patron-client relationships perceived by fishermen (C).

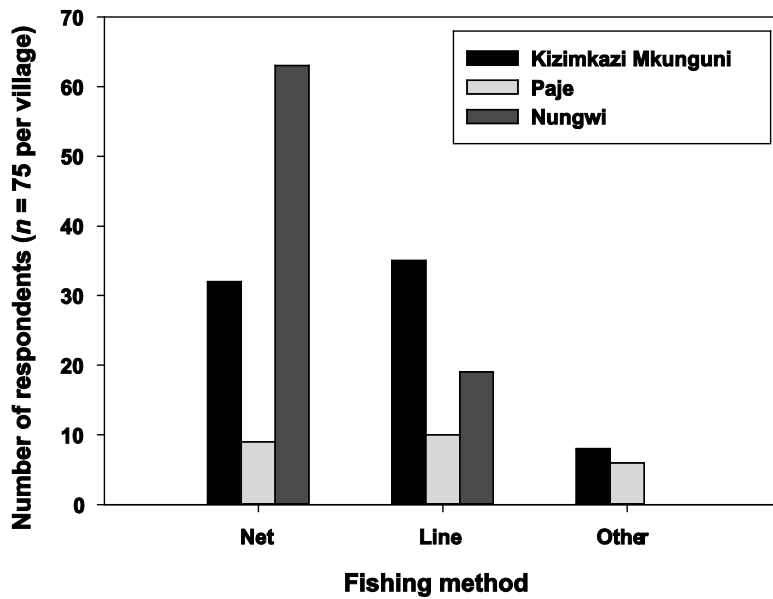


Figure 2.4 Fishing methods used by fishermen in patron-client relationships

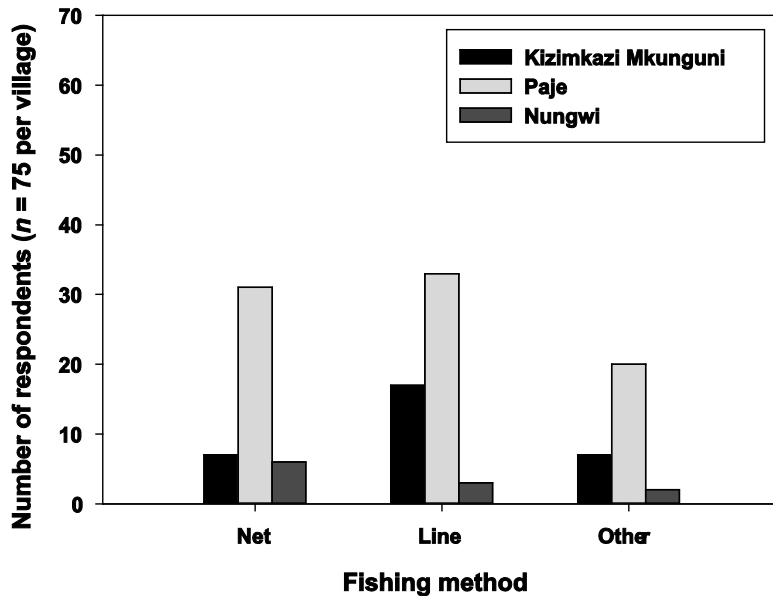


Figure 2.5 Fishing methods used by fishermen not in patron-client relationships

depend on a patron in hardship scenarios involving conflict was similar to those for other hardship scenarios. Other groupings include long-term hardship scenarios (improve household assets and child wants to attend university) and short-term hardship scenarios (illness in the family and household food shortage), although the short-term hardship scenario grouping was less congruent than the groupings of conflict and long-term hardship scenarios. Reliance on patron during times of fishing equipment failure was by far the most distinct hardship scenario.

In Paje (Fig 2.8) there was more similarity in the distribution of frequencies for each of the hardship scenarios, identifiable by the shorter ‘distance’ axis. Again hardship scenarios involving conflict were clustered into clades, this time together with declining marine natural resources. Fishing equipment failure remained the most distinct hardship scenario in which a fishing household would rely on a

patron. Short- and long-term hardship scenarios were mixed into clades (child wants to go to university and household food shortage), indicating a less time-restricted role for patrons.

The greatest difference in relative distances between frequencies for each hardship scenario was observed in Nungwi (Fig 2.9). Fishing equipment failure was by far the most distinct hardship scenario in which a fishing household would call upon a patron. Short- and long-term hardship scenarios were clustered at similar distances, as in Kizimkazi Mkunguni (improve household assets and child wants to go to university; illness in the family and household food shortage). Conflict scenarios were separated, although one conflict scenario (conflict with authorities) was clustered with declining marine natural resources.

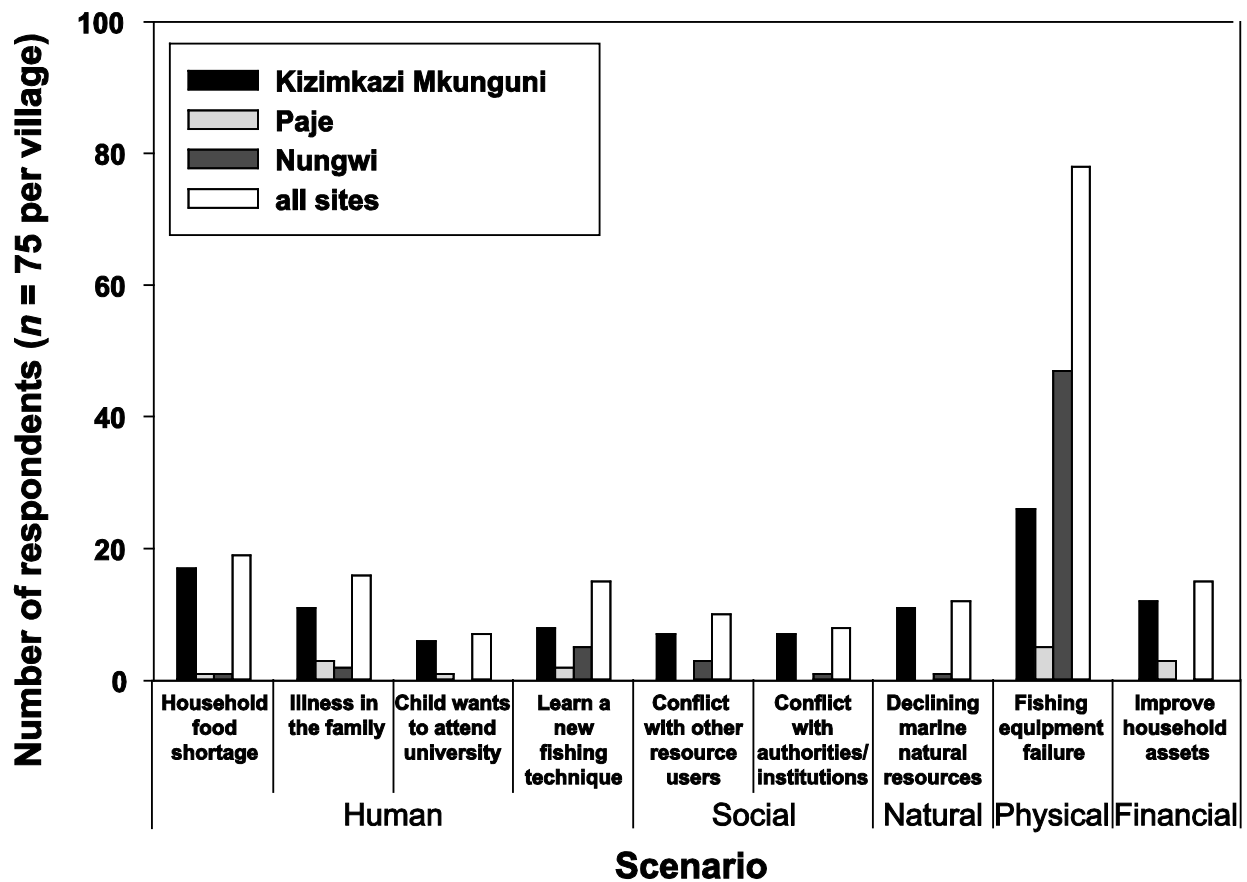


Figure 2.6 Frequency of fishermen respondent dependence on patrons for assistance in different hardship scenarios

Table 2.4 Chi-squared results for comparison of hardship scenarios between all villages combined

Hardship Scenario	Mean	Standard Deviation	Observation	Frequency	X^2	$p=$
Household food shortage	0.084	0.28	225	19	29.43	0.000***
Illness in the family	0.071	0.26	225	16	9.82	0.007**
Child wants to attend university	0.031	0.17	225	7	9.14	0.010**
Learn a new fishing technique	0.067	0.25	225	15	3.86	0.145
Conflict with other resource users	0.044	0.21	225	10	7.74	0.021*
Conflict with authorities	0.036	0.19	225	8	11.15	0.004**
Declining marine natural resources	0.053	0.23	225	12	19.54	0.000***
Fishing equipment failure	0.35	0.48	225	78	51.92	0.000***
Improve household assets	0.067	0.25	225	15	16.71	0.000***

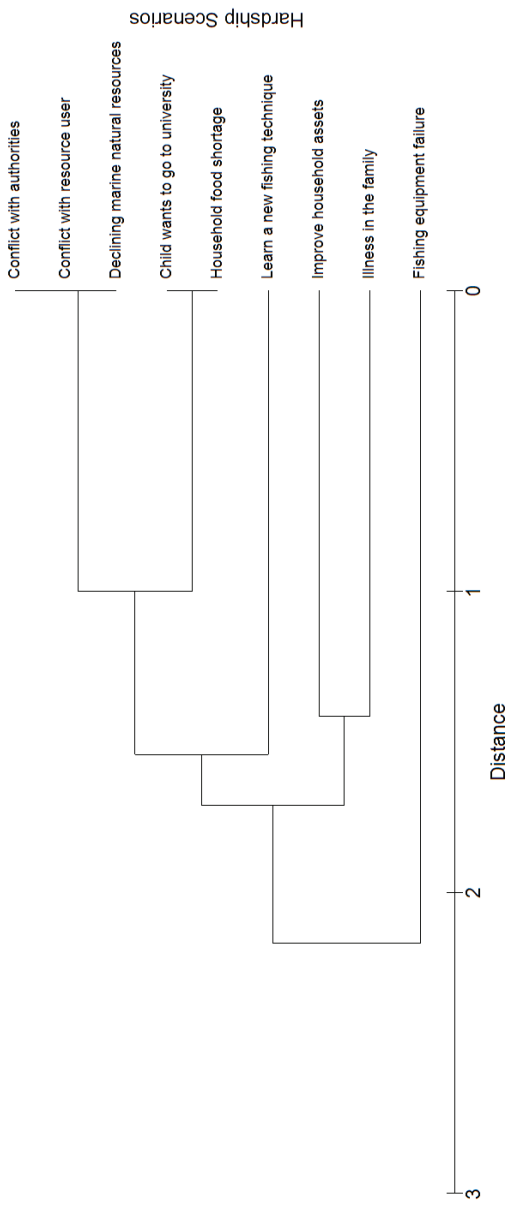


Figure 2.7 Dendrograms showing results of permutational cluster analysis on fisher-men-patron dependency for 9 hardship scenarios in Kizimkazi Mkunguni (note differences in x-axes between figs. 8-10). Shorter distances in the branches of the dendrogram mean higher similarity between the relative frequencies with which the difference scenarios were mentioned.

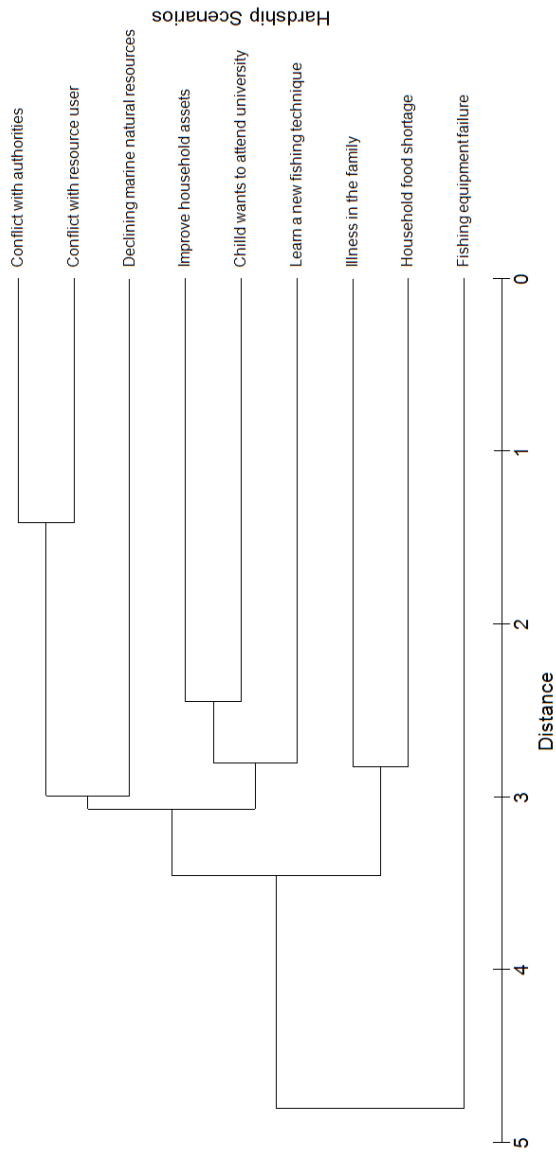


Figure 2.8 Dendrograms showing results of permutational cluster analysis on fisher-patron dependency for 9 hardship scenarios in Paje (note differences in x-axes between figs. 8-10). Shorter distances in the branches of the dendrogram mean higher similarity between the relative frequencies with which the difference scenarios were mentioned.

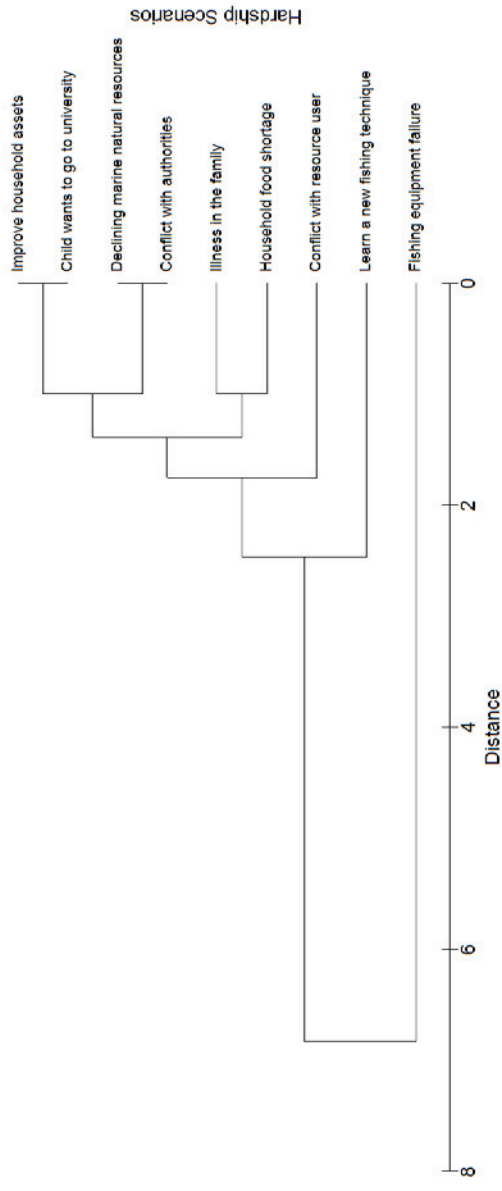


Figure 2.9 Dendrograms showing results of permutational cluster analysis on fishermen-patron dependency for 9 hardship scenarios in Nungwi (note differences in x-axes between figs. 8-10). Shorter distances in the branches of the dendrogram mean higher similarity between the relative frequencies with which the difference scenarios were mentioned.:

Livelihood diversification strategies

Respondents reported using up to 6 different livelihood strategies within their household (Fig. 2.10). Livelihoods captured comprised fishing, farming, paid employment, gleaning, informal labour, tourism and other. Most respondents across all villages reported 3 household livelihood strategies. In Kizimkazi Mkunguni there was no significant difference in the distribution of livelihood strategies between respondents with or without a patron, indicating that working for a patron did not compensate for other livelihood alternatives or offer new options for livelihood diversification. In Nungwi, the number of respondents without a patron was very low (9) and no significant difference in number of livelihood strategies was found between respondents with and without a patron ($\chi^2=6.17$, $p=0.290$). The same distribution of numbers of livelihood strategies occurred as in Paje, but with the distribution of respondents with a patron peaking around 30% for 2 household livelihood strategies.

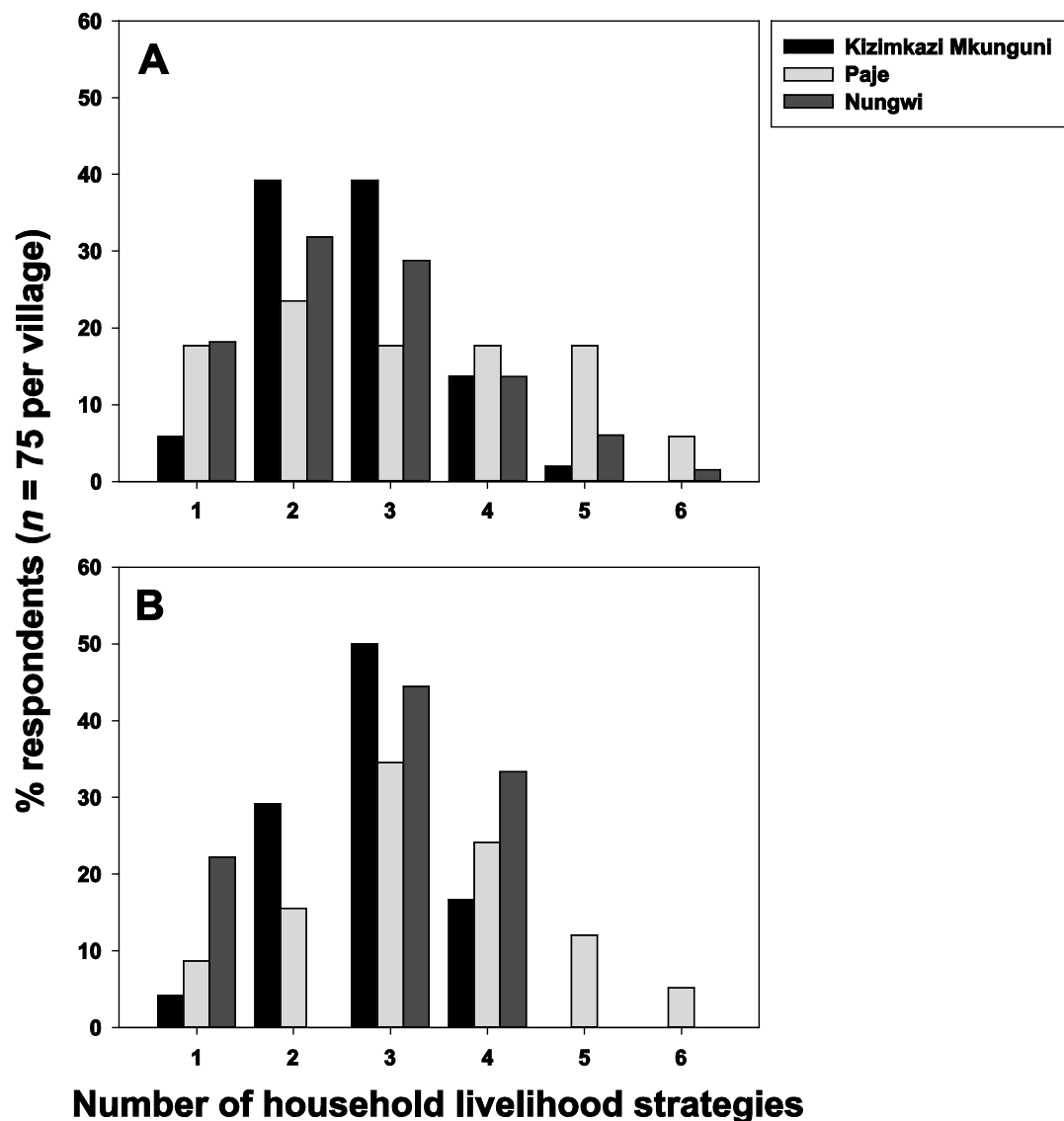


Figure 2.10 Numbers of household livelihood diversification strategies (comprising fishing, farming, paid employment, gleaning, informal labour, tourism and other) for fishermen respondents with (A) and without (B) patrons.

Fishery type and location

The type of fishery a respondent was engaged in was not significantly different between client- and non-client fishermen. However, there was a significant difference in respondent engagement in fishery types, subsistence, small and large fisheries, *between* all three locations ($\chi^2=25.71$, $p=0.000$). Chi-squared tests indicated no significant difference in access to near-shore or far-shore fishing grounds between fishermen with patrons and those without in all three villages. Having a patron did not therefore influence access to or choice of the fishing grounds or which kind of fishery a fisherman could engage in whereas the location of the village, and by proxy the type of natural resources available, did.

Discussion

Our findings indicate that there are differences in the degree to which coastal communities depend on patrons across Zanzibar. In addition, we find that patrons (or middlemen) have a potentially important function in natural resource management and poverty alleviation in coastal communities and are therefore crucial for mitigating vulnerability and driving effective coastal governance. We asked three important questions: firstly, what are the benefits that flow within this dyadic relationship? Secondly, in which parts within the SLA pentagon do patrons have the most influence on small-scale fishing households? And finally, how important are patron-client relationships in determining the livelihoods of these households?

Patron-client relationships in Zanzibar are multi-stranded, resting predominantly, according to the hardship scenario analysis, on client access to fishing equipment and assistance when fishing equipment fails. If we are to place the patron influence on client households within the SLA framework, the question arises whether fishing equipment is to be categorized as a physical or financial asset, given that fishermen can and do form alternative networks to acquire funds for more efficient technologies (see below). A patron has the financial capacity to invest in nets, boats and engines and thus provides fishermen not only with the equipment but also saves them the trouble of collective action to apply for government funding schemes, thus lowering transaction costs. Patrons, as seen in Indonesia (Acciaoli 2000; Pelras 2000; Ferse et al. 2014) and elsewhere (Ruddle 2011), provide fishing households with fishing equipment, a good that encapsulates physical, financial and social livelihood assets.

Additional complexity arises when considering the benefits fishermen perceive to obtain from their engagement in patron-client relationships. 'Social support', usually in the form of food when catches are low or a fisherman cannot work, was cited as being the most common benefit of having a patron. In the hardship scenario analysis, patrons were more often cited as providing assistance related directly to fishing, whereas household food shortages were mitigated by other social contacts such as families and neighbours (Ferrol-Schulte, unpublished data). However, the significance of the 'social support' response, mostly in the form of providing food in times of shortage, indicates that patrons also contribute to human assets in small-scale fishing households in both Kizimkazi Mkunguni and Nungwi, where patrons had a stronger presence than in Paje. In Paje, patrons may have been superseded or replaced by cooperatives as a means of access to more efficient fishing equipment and vessels. These cooperatives were widespread within the fishing community. Leaders were well-informed when it came to applying for government funding schemes and made no secret of the fact that the fishermen organized themselves into groups in order to fulfil necessary requirements that would provide more efficient and high-tech fishing equipment and vessels. Patrons therefore may play

an important role for coastal livelihoods in terms of food and income security, but they are not irreplaceable.

Patron-client relationships and their provision of access to markets, fishing technology and vessels did not influence the type of fishery respondents were engaged in, in contrast to other studies (Ferse et al. 2012; Thyresson et al. 2013; Ferse et al. 2014). Location, however, was a significant variable in explaining what type of fishery was accessible to fishermen, regardless of whether they were involved in a patron-client relationship or not (unpublished data). The nature of the coastal and marine environment differed in the three study locations: Kizimkazi Mkunguni is located within the Menai Bay Conservation Area in a sheltered bay, Paje faces a fringing reef behind which lies the Indian Ocean, whereas from Nungwi fishing grounds as far as Pemba, Leven Bank and even Kenya are accessible almost all year round. Further research is needed in these locations, and given the potential for migration of fishermen around the island, on the western side of Unguja, to determine the type of fishery and level of fishing effort residents engage in. Common explanations such as seasonality (Wiyono et al. 2006), catch per unit effort (CPUE) and/or catch information (Pet-Soede et al. 2001), and revenue (Salas et al. 2004) may not have as great an impact on choice of fishing method as the characteristics of the fishing grounds themselves. We have not, however, accounted for gear-specific issues, market access or the increasing complexity of technology in this analysis. More detailed interdisciplinary analyses (Silva 2006) on local natural features (reefs, fish stocks, seasonal changes) in combination with social processes (tourism, infrastructure, knowledge-transfer) are needed to explain fisheries, fishing effort and associated livelihood dynamics in these coastal communities.

Patron-client relationships are unevenly distributed across our study sites. The livelihood diversification analysis also indicates that the income provided by a patron did not eliminate the need for other forms of income or contribute to a diversification of livelihood options. Indeed, it would appear that the number of livelihoods within fishing households is not affected by having a patron. In this case, the type of livelihood and/or its effectiveness may determine the importance of a patron for fishing households. Employment under a patron is regarded as a means of acquiring income – a short-term coping strategy for dealing with vulnerability in the forms of poverty and uncertainty (Wood 2003). Patron-client relationships seem to be based on economic incentives, where short-term assistance such as food (usually fish) and money are used to keep fishermen obligated to a particular patron – a form of client competition exacerbated by economic declines, such as in Indonesia after the 1997 Asian financial crisis (Idrus 2009). Should fishermen decide to take their labour elsewhere, a patron loses his own source of income, namely, the profit he makes from selling fish. Low levels of education and therefore limited opportunities to find alternative income sources mean client fishermen remain vulnerable to exploitation and predatory behaviour by patrons in the long term. Fishing provides on-the-job training, a shared identity and an accessible means of income for those without much formal education or alternative prospects. The relative absence of patron-client relationships in Paje, but high presence of fishing cooperatives supports this idea. Our findings add poor education and limited opportunities to the list of reasons why these relationships are formed and, in some cases, continue over time despite unfavourable working conditions and feelings of exploitation. The increasingly economic nature of patron-client relationships, driven by poor education and limited opportunities, has been described as augmenting the vulnerability of small-scale fishing households, and this trend seems to be increasing (Wood 2003; Ferse et al. 2012).

The contributions of patron-client relationships to long-term livelihood security and vulnerability mitigation appear to be small on Zanzibar. The predominantly economic nature of these arrangements improves the adaptive capacity of fishing households and can act as a strategy for coping with

vulnerability. This role of patron-client relationships as a short-term coping strategy is thus similar to that observed by Ferse et al. (2012a) in Indonesia. The multi-stranded nature of patron-client relations is exemplified by the term “*anak buah*” (crew, follower or apprentice; literally ‘fruit child’) used for clients in the Indonesian case. This short-term strategy does not undermine the importance of patron-client relationships for small-scale fishing household livelihoods, but it does explain the rationale behind natural resource exploitation at the scale it currently exists at in our research sites. A fuller discussion of whether the nature of patron-client relationships is changing from a multi-stranded complex system to a more economic arrangement as a result of development (as per Theobald 2009) is not within the scope of this paper.

Although differences in the degree to which coastal communities depend on patrons within Zanzibar exist, it remains unclear where these differences stem from. Our findings are in accordance with Crona et al. (2010) in that patrons provide mainly financial and physical assets to coastal households. Yet our research indicates that the degree of dependence and the role patrons play in these communities cannot be addressed effectively by one-size-fits-all coastal governance aimed at regulating these complex, varied and important relationships.

Patron-client systems and coastal governance

Our findings indicate that patrons do indeed influence livelihood security in coastal fishing households. Patrons provide a means of entering into the varied markets for natural resources that exist on Zanzibar through the provision of physical assets such as boats and fishing equipment. Importantly, we observed that the role of patrons varied considerably between locations. In Paje, local organization of fishermen enabled them to tap into resources usually accessed through patrons and thus to find alternative forms of augmenting their livelihood assets. The question for coastal governance then arises as to whether patron-client ties are beneficial to the poorer households and the ecological system that management strategies are often aimed at. Do patrons mitigate vulnerability and contribute to natural resource management, or do they exploit or even intensify the state of dependence of coastal communities and/or exacerbate ecological degradation and resource decline?

This research examines the local findings of Crona et al. (2010) at a higher resolution on Zanzibar and suggests a new perspective on the importance of middlemen in patron-client relationships in small-scale fishing households. In Crona et al. (2010), middlemen are identified as key players in resource extraction, channelling market demand and financial (mainly credit) arrangements. We find that the middleman engaged in a relationship with client fishermen extends his influence into the social, human and physical assets of a coastal fishing household. Moreover, this influence takes on different shapes and depths in different locations across Zanzibar.

The diversity in services provided and roles played by patrons within individual households means that this debate will continue beyond this paper. There is no clear-cut hero or villain in a patron-client relationship in our case study. Each remains dependent upon the other. The short-term contributions to livelihood security through food or credit in a developing country are of course crucial to the everyday survival of fishing households until alternative social security solutions are found. Yet the long-term effects of patron-client relationships on coastal household vulnerability and natural resource management on Zanzibar remain unknown. The lesson from this research for coastal governance is that managers and practitioners must appreciate the importance of patron-client relationships in defining how coastal communities depend on these forms of social security back-ups, how deeply rooted that dependence can be and what the consequences for marine resources are. The example of Paje highlights that alternative forms of organization amenable to government support are feasible.

Crona et al. (2010) already underlined the value of middlemen as ‘knowledge-brokers’ and we firmly support this idea. Patrons, even exploitative patrons, are not to be demonized by coastal management. Instead their priorities and influence can be transformed into a useful buy-in for coastal managers. While their position as important providers of social security for fishing households is likely to cause unsustainable resource use, their locally-relevant knowledge and integration into society is a management opportunity not to be missed.

Limitations

There are some significant limitations to this research. An inter-seasonal or –annual comparison was not possible as data was collected during only one season (April-July – the southwest monsoon season). Therefore our findings only relate to this season. Although the role of patrons in coastal community livelihoods is the central theme of this paper and not their influence on natural resources targeted, we cannot address the question as to whether these roles change over time, either as a result of short-term variation in resource availability, or long-term changes in market structures and technology. However, our findings correspond to those of Crona et al. (2010), where more extensive data collection over a longer time-frame in different seasons was carried out.

Conclusion

The importance of patrons in determining which species are targeted in fishing in Zanzibar has been shown in a recent study (Thyresson et al. 2013). For patrons to become constructively involved in natural resource management for long-term sustainability, the apparent short-termism in this type of decision-making needs to be addressed. On Zanzibar, patrons play a strong and, in some case, replaceable role in natural resource exploitation but a small and variable role in securing the level of clients’ livelihoods. We do not yet understand under which circumstances patrons are dispensable, but we can assume that one or multiple actors must fulfil the same or more of the social security functions we have outlined in this paper. Nonetheless, the impacts of patron-client relations on social-ecological dynamics are considerable, so that we need to develop strategies to achieve long-term sustainability that explicitly include the sustainability-enhancing potentials of patron-client relations, or at least the functions that they entail. Rising prices of fish, mainly as a result of growing tourism, buffer the feedback from the environment to the social system and so short-termism continues. Patrons carry the environmentally under-informed feedback from the market to the producer realm. They act as both a source of destruction and of renewal for many components of the Zanzibari coastal social-ecological system, as outlined here. Although patron-client relationships are not the lynchpin of livelihood security in the sites studied, they remain a valuable source of income and food security. There is a need to weaken the exploitative aspects we have here emphasized, but options for affecting and using the leverage (room for manoeuvre) of patrons in social-ecological dynamics are only just being identified.

Chapter 3: Coastal livelihood vulnerability to marine resource degradation: a review of the Indonesian national coastal and marine policy framework

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Abstract: In rapidly developing countries, where large sections of the population are highly dependent on marine resources, coastal livelihoods are vulnerable to sudden shocks and long-term change. National policy can attempt to mitigate this vulnerability within a multi-level framework by addressing the three aspects of vulnerability (exposure, sensitivity, adaptive capacity) through well-documented interventions. This article reviews the Indonesian policy framework for coastal and marine policy interventions that either directly or indirectly address different dimensions of coastal livelihood vulnerability. The findings show that the policy environment for addressing coastal livelihood vulnerability is heavily based on developing adaptive capacity and to certain extent sensitivity without adequately addressing exposure, the initial cause of vulnerability. In addition, the complexities and inconsistencies within the Indonesian governmental structures, as well as more general issues of funding gaps and poor coordination, mean that policies created at national level, rarely filter down to provide the intended benefits to coastal communities. It is recommended that practitioners and policy-makers engage in a more cohesive and balanced approach to addressing livelihood vulnerability in coastal management by focusing more on the causes of the disease, exposure, rather than healing just the symptoms.

Keywords: Indonesia, livelihoods, coastal, vulnerability, policy, marine resources

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Introduction

Marine resources and coastal livelihoods

The majority of the world's population lives in coastal areas and human populations derive a variety of benefits from functions, goods and services marine ecosystems provide. The livelihoods of coastal communities are strongly linked to the health of the coastal and marine ecosystems on which the majority of these communities rely (Salafsky and Wollenberg 2000). Globally, the fisheries sector alone provides about 170 million jobs, and more than 1.5 billion people rely on marine resources for their protein intake (United Nations Secretary-General's High-Level Panel on Global Sustainability 2012). Small-scale, or artisanal fisheries employ the vast majority of the world's fishers (Andrew et al. 2007). Of the small-scale fishers, over a quarter fish on coral reefs, and half of all coral reef fishers are found in Southeast Asia (Teh et al. 2013). Marine ecosystems in many regions of the world, however, show alarming signs of degradation (World Bank 2006).

Increasing demand on coastal and marine resources, especially in the tropics, has led to extensive and sometimes irreversible damage to the marine environment, whilst simultaneously compromising livelihoods (Tundi et al. 2005). This situation is particularly grave in Southeast Asia, where over 90% of coral reefs are at risk from local threats (Burke et al. 2011). The amount of overexploited marine fish stocks has increased steadily over the past three decades to around one third, and less than 15% of fish stocks still hold potential for increased exploitation (Food and Agriculture Organization (FAO) 2012). In the 2008 report 'The Sunken Billions', the total economic loss caused by the global decline in fish stocks is estimated to be approximately two trillion dollars for the last 3 decades (World Bank and Food and Agriculture Organization (FAO) 2008). The loss of functions, goods and services marine ecosystems provide is a significant barrier to the achievement of the Millennium Development Goals to eradicate extreme poverty and hunger (Allison and Ellis 2001). The vulnerability of marine resource-dependent sectors of society to degradation of these resources, particularly in developing countries, requires policy responses that address the different factors contributing to this vulnerability (Cinner et al. 2012). Indonesia is taken as a case study to examine how national marine policy addresses vulnerability arising from marine resource dependency.

The Indonesian case

Indonesia is the world's largest archipelagic nation consisting of more than 17,000 islands. It is located within the Coral Triangle, the global hotspot of marine biodiversity. The country's coastline of about 81,000 km includes around 4,000 ha of mangrove forests and the territory encompasses 5.8 million km² of sea area, of which approximately 51,000 km² are coral reefs (Syarif 2009). It has been estimated that in 2005, 7.3 million people (or 8% of the working population (Badan Pusat Statistik (BPS) 2005)) were employed directly or indirectly by the fisheries sector, with the marine fisheries sector providing US\$ 5.2 billion to the country's national gross domestic product (GDP) (Hoegh-Guldberg et al. 2009).

The condition of Indonesia's marine ecosystems reflects the global trend. In 2011, the Ministry of Marine Affairs and Fisheries passed a decree (Kep. 45/Men/2011) to assess the status of marine fisheries resources in the eleven Indonesian fisheries management areas (*Wilayah Pengelolaan Perikanan*). The results showed clear signs of overexploitation (defined as fishing levels higher than the maximum sustainable yield, with decreasing yield at increasing fishing effort) in all management areas, particularly for small pelagic species [(Keputusan Menteri Kelautan dan Perikanan 2011). Over the last few decades, unsustainable use of marine resources has dramatically risen in Indonesia and the degradation of marine ecosystems including coral reefs, seagrass meadows and mangroves pose major threats to the viability of coastal ecosystems (Siry 2011) from both land- and sea-based human

activities (Waddell 2009). The cumulative impact of the human drivers of change on marine ecosystems causes an ever-increasing concern for the livelihoods of coastal populations, especially the ones living in small coastal communities where marine natural resource dependence is often high. The main coastal pressures arise from population growth, pollution, exploitation of natural resources (Kusuma-Atmadja and Purwaka 1996; Burke et al. 2011) and climate change (Cinner et al. 2012). In addition, unsustainable practices including coral mining, anchoring in reef areas and destructive fishing methods such as cyanide fishing, dynamite fishing and the use of fine mesh nets (Burke et al. 2011), are jeopardizing environmental quality crucial for sustaining vulnerable local livelihoods (Satria et al. 2006; Wilkinson 2008; Glaser et al. 2010a; Ferse et al. 2012; Ferse et al. 2014). Nowadays, 93% of Indonesia's coral reefs are at risk from these local threats¹ (Burke et al. 2011). This situation is further exacerbated by the predicted impacts of global climate change, which is a key threat to coral reefs and marine fisheries (Hughes et al. 2003; Allison et al. 2009). Indonesia is projected to experience the strongest decline in marine fisheries of any nation – total marine fish catches are predicted to decrease by over 20% until 2055 (Cheung et al. 2010). Particularly for the livelihoods of inhabitants of many small rural coastal villages, marine ecosystems play a fundamental role (Dahuri and Dutton 1999; Satria et al. 2006; Ferse et al. 2014). Households in coastal communities thus are particularly vulnerable to the impacts of ongoing marine resource degradation.

Vulnerability in coastal and marine social-ecological systems

The concept of vulnerability is multi-faceted and has undergone several changes over time (Adger 2006). For this article, vulnerability is understood as “the degree to which a system is susceptible to and is unable to cope with adverse effects” (Adger 2006) of resource degradation. Vulnerability is frequently understood as comprising the three key dimensions exposure (E), sensitivity (S) and adaptive capacity (AC) (McCarthy et al. 2001; Turner et al. 2003; Adger 2006; Smit and Wandel 2006; Allison et al. 2009; Cinner et al. 2012). In the context of marine resources, exposure relates to the extent to which a system is subject to various environmental and anthropogenic factors such as climatic events, fishing impacts, nutrient inputs or habitat modification (Gallopín 2006; Smit and Wandel 2006; Cinner et al. 2012). For example, it may describe the frequency and duration with which a coral reef experiences a thermal anomaly, or the amount of trawling that a particular benthic area is subject to. With regard to fishing communities, Cinner et al. (Cinner et al. 2013) argue that socioeconomic exposure to marine resource degradation is a result of ecological vulnerability of those marine resources (which is caused by both environmental and socio-economic drivers). Sensitivity is the degree to which a system is affected or modified by perturbations or stressors (Gallopín 2006; McClanahan and Cinner 2012; Cinner et al. 2012). There are both ecological and socio-economic components of sensitivity. For example, the stock of a species that grows and reproduces slowly is more sensitive to the removal of large individuals than that of an early-reproducing, fast-growing species, and a community of heat-tolerant coral species is less sensitive to a warming event than one comprising highly sensitive species. Similarly, a coastal community with low dependence on marine resources is not overly sensitive to degradation of these resources. Adaptive capacity refers to the ability of a system to adapt and respond to change and to minimize, cope with, and recover from the consequences of change (Adger and Vincent 2005; Smit and Wandel 2006; Cinner et al. 2012). The socio-economic constituents of adaptive capacity can be broadly grouped into four key clusters: flexibility, capacity to learn, capacity to organize, and assets (Cinner et al. 2009a). Adaptive capacity is related to, and sometimes equated with, resilience (Turner et al. 2003; Gallopín 2006; Smit and Wandel 2006). While the latter has conceptual origins in ecology, it is increasingly applied to linked

¹ Note that while these threats are localized in their impact (as opposed e.g. to large-scale eutrophication from terrestrial run-off or changes in ocean temperature and chemistry), they are often driven by dynamics at higher levels. An example is the use of cyanide, which is driven to a large extent by the demand for live reef fish on Asian markets (particularly Hong Kong and Singapore) and the international trade in marine ornamentals.

social-ecological systems (Folke 2006). Resilient social-ecological systems are capable of absorbing larger shocks and long-term changes and contain the components needed for system survival (Folke et al. 2002). Resilience is usually associated with adaptivity and diversity, including the diversity of species, of human capacities and of economic options (Folke et al. 2002). In line with this requirement, marine resource conservation attempts call for adaptive approaches and the provision of alternative livelihood options in order to decrease the pressure on marine ecosystems and increase the resilience of small rural coastal communities (Christie 2004; Christie and White 2007b).

Methods

Research approach

The continuing decline of marine resource abundance and the degradation of marine ecosystems result to a large extent from policies that are still structured around unsustainable approaches to marine resource use (United Nations Secretary-General's High-Level Panel on Global Sustainability 2012). With respect to livelihoods based in coastal and marine social-ecological systems (CM-SES), national level law, policy and actions play a critical role in reducing vulnerability of resource dependent coastal communities (Cinner et al. 2012; Garmestani et al. 2013). Particularly in decentralized countries, such as Indonesia, fragmented legal systems are a common problem for an integrated policy framework (Wever et al. 2012). Yet, clear directions need to be set by a consistent policy framework that addresses coastal vulnerability by building adaptive capacity (Folke et al. 2002; Smith et al. 2013). This includes enabling flexible multi-level, multi-sector governance (Folke et al. 2002; Ferse et al. 2014) and generating a diverse livelihood portfolio to increase resilience of coastal communities (Cinner and Bodin 2010; Glaeser and Glaser 2011; Ferse et al. 2012; von Essen et al. 2013).

This article aims to provide feedback about the Indonesian policy framework for coastal and marine livelihoods to policy makers in order to improve the regulatory framework towards reducing the livelihood vulnerability of coastal communities. Based on the state of the marine environment and the problems coastal communities face, the analysis centres on the question of whether the measures set by the Indonesian policy framework are appropriate and cohesive enough to address the different scales and components of vulnerability and thus reduce vulnerability in the face of marine resource degradation. Data was collected through a desk-based study using sources from the legislative database FAOLEX, the Indonesian Ministry of Marine Affairs and Fisheries (KKP) and the International Union for the Conservation of Nature (IUCN). Legal documents, policy plans, and secondary literature related to CM-SES in Indonesia were evaluated at the national level.

In order for policy to adequately address vulnerability, the different dimensions and underlying causes of vulnerability need to be understood (Andrew et al. 2007; Cinner et al. 2012). The starting point of this analysis was thus a review of the concept of vulnerability to resource degradation in the context of CM-SES. This provided the basis for an identification of a number of policy interventions that address different sources of livelihood vulnerability which are described in section 3.2.2 and Table 3.1. Subsequently, the overall Indonesian umbrella framework of fisheries and marine conservation policy is analysed in the light of its political context in order to illuminate the opportunities and challenges for reducing vulnerability of coastal communities in Indonesia. Finally, the relevant legal documents were examined as to whether or not the identified interventions are enclosed in the respective documents to gain an understanding of which aspects of livelihood vulnerability received a relatively high or low attention and analyse if livelihood vulnerability, based on the three dimensions of vulnerability, is adequately addressed by Indonesian policy. Legislation that focused on commercial-

scale fisheries was disregarded from the analysis as the focus of this paper is on small-scale fishing livelihoods in coastal communities.

Coastal and marine policy interventions that address vulnerability

Indonesian coastal and marine policies were reviewed for 11 well-documented coastal and marine policy interventions that either directly or indirectly address different dimensions of coastal livelihood vulnerability. The listed references further describe each of the types of interventions. Interventions are categorized according to the dimensions of vulnerability they address. While habitat degradation can be caused by both local impacts (e.g. from the use of destructive fishing gears) and larger-scale factors (such as climate change), this study focuses on policy interventions aimed at local ecosystem users, as these are most intimately linked to coastal ecosystems.

Focusing on coastal communities and associated ecosystems, livelihood exposure to marine habitat degradation (i.e. ecological vulnerability) can be reduced by measures that decrease degradation, such as restrictions and ban of gear types or limitation of catches (e.g., (Bell et al. 2009; Burke et al. 2011)), together with measures that improve management effectiveness, or strengthen or restore ecosystem health (e.g., (Bellwood et al. 2004; World Bank 2009; Wade et al. 2013)). Interventions that reduce livelihood sensitivity include provisions for alternative livelihoods (although these can have counterproductive outcomes if inadequately planned and implemented (Cinner et al. 2012; Cinner 2014)), subsidies, assistance in fishing diversification and intensification, improved market access (all of which can both decrease and increase sensitivity, depending on which species are targeted and how measures are distributed within a community (Cinner et al. 2012; Cinner et al. 2013)), and investment in improved health and nutrition (Bell et al. 2009). The majority of policy interventions identified and recommended to address coastal livelihood vulnerability are aimed at enhancing the adaptive capacity of coastal households and communities (Cinner et al. 2012). Measures that support diversification within or outside of fisheries, or that strengthen health and environmental awareness, not only reduce sensitivity to resource degradation but also enhance adaptive capacity. Again, if not carefully planned, such interventions can backfire and increase, rather than reduce, livelihood vulnerability (Cinner et al. 2013; Cinner 2014). Improved management measures, such as gear-based-, participatory- and co-management (Cinner et al. 2009d; Cinner et al. 2012), and policies that enhance social and cultural capital or aim for capacity building, are frequently recommended to enhance adaptive capacity, as they enable communities to better anticipate and organize to cope with change (Berkes and Seixas 2005). A further measure that enhances households' and communities' adaptive capacity is the provision of credit systems (Smit and Wandel 2006). In the Indonesian context, this aspect is of particular importance as it addresses the prevalent dependence on patrons for credit which has negative implications for the sustainable use of marine resources and the adaptive capacity of the dependent fishers (Ferse et al. 2014).

Results & Discussion

Indonesian umbrella framework of fisheries and marine conservation policy

Indonesia's national Decentralization Law 22/1999, in conjunction with Law 32/2004, the Fisheries Law (31/2004) and Coastal Zone Management Law (27/2007, revised by Law 1/2014), acts as an umbrella framework for fisheries and marine conservation policy. It provides direction for national, regional and local policies on coastal and marine management and livelihoods but leaves ample scope for specification and interpretation on how to implement the regulations (Wever et al. 2012). A typology of the Indonesian legislation hierarchy is outlined in Table 3.2.

Table 3.1 Descriptions of marine and coastal policy interventions addressing livelihood vulnerability. (E-exposure/ S-sensitivity/ A-adaptive capacity)

Intervention	Description	Vulnerability dimensions addressed	References
Ban destructive practices	Cyanide, explosives, mesh sizes, drag nets, purse seines	E	[20,61,72,73]
Strengthening ecosystem health	Conservation measure, restoration or maintenance of ecosystem function or services	E	[72,74-77]
Strategies for coastal and/or fisheries management	Gear restrictions, total allowable catch, closed seasons, size/weight restrictions, licensing, reporting, monitoring	E, A	[12,16,78]
Legal procedures for lack of compliance	Enforcement measures, penalties	E, A	[39,61,79-81]
Provisions for conducting aquaculture	Provision of equipment, species allocations	S, A	[8,47,69,82]
Improving health or education	Clinics, health programmes, health and/or environmental education	S, A	[28,47,83-85]
Assistance with intensification, capitalization of existing fishing practices	Distribution of nets, fuel subsidization, increased market access	S, A	[10,86,87]
Consider/enhance social and/or cultural capital	<i>Sasi laut</i> , local management schemes, local social/religious customs	A	[79,88-90]
Call for capacity building	Enhancement of organizational, institutional, human, physical or resource assets	A	[20,91-93]
Community participation in management	Stakeholder consultation, active roles in decision-making, local enforcement	A	[20,42,58]
Provision of credit systems	Micro-finance, subsidies, loans	A	[94,95]

Law 22/1999, which was revised and amended by Law 32/2004, provides for the decentralization of administration to provincial, district and municipal governments (Articles 3 and 9). Provincial governments (referred to in the amendment as “local” governments) obtained jurisdiction over the marine and coastal zone and its natural resources up to 12 nautical miles from the coastline. District and city governments (Kabupaten/ Kota) are authorized to autonomously manage one third of this area (i.e., up to 4 miles from shore) (Satria and Matsuda 2004). As a result, these branches are now required to adopt, specify and enforce the national regulations related to marine and coastal issues within their jurisdictional territory (Patlis et al. 2001).

Table 3.2 Hierarchy of Indonesian national-level legislation

Indonesian	English
Undang-Undang	Law
Peraturan Pemerintah	Government Regulation
Peraturan Presiden	Presidential Regulation
Keputusan Presiden	Presidential Decree
Peraturan Menteri	Ministerial Regulation
Keputusan Menteri	Ministerial Decree
Instruksi Presiden	Presidential Instruction
Peraturan Dirjen	General Director Regulations

The present overall framework in fisheries management was launched in 2004 by national Law No. 31/2004 on Fisheries (also called *Fisheries Act*). It guides fisheries management in coastal areas and Indonesia's Exclusive Economic Zone (Syarif 2009). The Ministry of Marine Affairs and Fisheries (*Kementerian Kelautan dan Perikanan/KKP*) was created in 1999 to integrate different sectoral policies (Tiwi 2004). The *Fisheries Act* gave KKP authority to implement measures to prevent illegal and destructive fishing, incorporating the definition and prohibition of destructive fishing methods. It grants KKP the right to determine protected fish species and marine protected areas and defines the Minister's responsibility for planning fisheries management, determining fish stocks and setting allowable catch rates. The law also contains a variety of provisions regarding fish cultivation, food additives, fishing enterprises and fish processing which remain to be further specified (Waddell 2009).

The Coastal Zone and Small Islands Management Act was enacted in 2007 (Law 27/2007) and revised by Law No. 1, 2014. It offers a framework for planning, coordination and integration of coastal management by specifying decentralization in the coastal marine realm and encourages community-based management schemes (Siry 2011). General provisions regulate administration and implementation, monitoring and evaluation as well as conflict resolution and funding. The law also promotes voluntary, incentive-based programs for local integrated coastal management initiatives (Siry 2006) and emphasizes the importance of public consultation (Wever et al. 2012). The revision of the Coastal Zone and Small Islands Management Act (Law 1/2014) includes the replacement of a controversial measure known as Coastal Waters Use Right (*Hak Pengusahaan Perairan Pesisir*, or HP-3) with a permit system, introduces provisions for local governments to assist local and traditional communities to obtain these permits, and places restrictions on the utilization of small islands and coastal waters by foreign enterprises. It furthermore contains provisions to strengthen the role of local and traditional communities in coastal management and to provide financial and material assistance and capacity building to coastal communities.

Shortcomings in policy implementation

The Indonesian national policy framework encompasses various means of addressing sensitivity and adaptive capacity of coastal communities to marine resource degradation. Many provisions exist for

management, monitoring and reporting. Yet, it appears that coastal community vulnerability remains high, resilience low and therefore, policy ineffective. Few concrete strategies were found concerning implementation or financial support for the projects outlined in the various policies. As stated in Law 12/2010, it is simply assumed that finances will be covered by the State Budget without further consideration of whether and/or how this will be possible. This, along with the low priority given to community participation in coastal management and decision-making, may contribute to the failure of small-scale fishery development programs (Smit and Wandel 2006; Glaser et al. 2010c; Nasuchon and Charles 2010). The increased provisions for communities' role in management introduced in Law 1/2014 are a positive signal in this respect, but it remains to be seen how these intentions will play out in reality.

The two main legal provisions Law No. 31/2004 on fisheries and Law No. 27/2007 on the Management of Coastal Areas and Small Islands can be seen as seedlings of an ecosystem-based management approach for fisheries and coastal marine areas (Waddell 2009) in a garden continually overgrown with policies driving intensified exploitation of coastal marine resources (Sievanen et al. 2005; Ferse et al. 2014). The ideas are progressive, if limited to the sensitivity and adaptive capacity arenas. There are signs that ecosystem-based management is gaining stronger traction in Indonesian marine policy: KKP has established a national task force for the adoption of ecosystem-based fisheries management (EAFM), and trials for testing indicators of coastal ecosystem status and pilot projects of EAFM implementation have been carried out. Nonetheless, Law 27/2007 and its revision (Law 1/2014) still contain at least two weaknesses. First, this law defines coastal waters as up to 12 miles from the coastline. However, for terrestrial areas, there is no clear definition. It states that the terrestrial part of a coastal area expands along the size of coastal sub-district (Indonesian: *kecamatan*) area, which is varied from place to place. It does not outline measures for managing the terrestrial part of the coastal zone, an important consideration when managing pollution, aquaculture and non-fisheries-based alternative livelihoods. Second, even though the controversial HP-3 has been revoked for using a blanket-approach to marine resource ownership that placed local communities into one arena with businesses and government without accounting for differences in relative power and resources (predictably to the relative disadvantage of the communities), After Law 27/2007 went through a judicial review by the constitutional court in 2011, the HP-3 articles were considered as having no binding power due to their inconsistency with the Indonesian Constitution. The Indonesian government reacted by amending the law within three years (Constitutional Court of Indonesia 2010). The new law (Law 01/2014) acknowledges indigenous communities and their customary laws, which legalizes local marine area management. However, the new law still opens up the possibility of using the marine coastal zone to any business entity, including foreign investors, and for non-fisheries/aquaculture use through the provision of territorial and management licences (*izin lokasi dan izin pengelolaan*). Although indigenous communities are exempt from the process, other communities still need to provide licences. This means that, until communities acquire such licences current activities of community in coastal and small islands such as salt mining or aquaculture are considered illegal. The new law tries avoid marginalizing these communities by stating that the government shall facilitate the provision of such licences, especially in the case of subsistence activities. Furthermore, the law acknowledges 'traditional rights' of fishing and other related activities within the area. Yet the meaning of "traditional rights" remains open to interpretation. The case of the MoU Box around the Indonesian and Australian borders shows how the ambiguity in the term "traditional" can undermine the effectiveness of marine natural resource management (Adhuri & Visser 2006). In regard to Law 1/2014, the term 'traditional right' has to be defined in order to avoid adding more pressure to marine ecosystem for the sake of facilitating provision of the licences for coastal communities.

Considering current business practices in Indonesia, the second weakness might pose particular threats in the form of marginalization of poor fishers and coastal communities, as well as for sustainable and equitable fish production. Furthermore, the complex and sometimes overlapping formal legal regulations (Wever et al. 2012), the long process of drafting legislation, the adaptation of government bodies to new responsibilities (Siry 2011) and ineffective law enforcement (Chozin 2008) make it unlikely that the official governance system, even though decentralized, is able to respond quickly and adequately to marginalization of coastal communities by business activities, and to coastal community vulnerability to marine resource degradation more generally.

To date, the good intentions at the national policy level remain intangible to local government and local coastal communities and seem to have had little effect on the resilience of Indonesia's CM-SES. Low capacity, inadequate funding and/ or coordination between institutions has led to a lack of systematic, logical implementation of these policy interventions on the ground (Waddell 2009; Winter 2009). There appears to be no consistent or coordinated plan to help coastal communities to exit the CM-SES poverty trap (Cinner 2011) and become more resilient. Local institutions (such as patrons and community leaders) may be better positioned to implement contextually relevant strategies to address coastal community vulnerability (Glaser et al. 2010a; Ferrol-Schulte et al. 2014). Furthermore, corruption on many government and local levels undermines government effectiveness and delivery of important services to marginalized members of society, and weakens marine management efforts, impairing adaptive capacity and exacerbating vulnerability (Adger 1999; McClanahan and Cinner 2012; Cinner et al. 2012). Efforts that aim to improve governance by making the political processes more transparent and accountable, improving participation of civil society, and making law enforcement more equitable and reliable usually originate from outside the fisheries sector (i.e. NGOs) but contribute to improved management of small-scale fisheries (Andrew et al. 2007).

Vulnerability concept in the Indonesian national policy framework

This section examines the relevant legal documents as to which interventions are enclosed in the policy and discusses if livelihood vulnerability in terms of exposure, sensitivity and adaptive capacity (Gallopín 2006; Cinner et al. 2012) is adequately addressed by Indonesian policy. In total, 28 legislative documents in the national policy framework were found that relate to various interventions intended to mitigate coastal livelihood vulnerability in Indonesia since 2001. The distribution of the different interventions across the spectrum of Indonesian policy on coastal vulnerability is shown in Table 3.3.

A 'call for capacity building' was found in 12 documents, making it the most common item in coastal livelihood vulnerability-related policy. This was followed by 'strategies for coastal/fisheries management', 'provisions of credit systems', 'improved health/education' and 'assistance with intensification/capitalization' with 9 mentions each.

There were few 'provisions for conducting aquaculture', which together with 'community participation in management' and 'ban destructive practices' received the lowest number of references at 4 mentions each. Few policies stated specific 'legal procedures for lack of compliance' or highlighted a 'concern for ecosystem health' (6 mentions each).

The analysis shows that the framework aims to, if not explicitly, address all three components of vulnerability. However, Table 3 shows an imbalance in policy interventions addressing these three pillars individually. The largest number of mentions across all policy interventions was for measures aimed at building adaptive capacity of coastal communities, followed by measures to address their

sensitivity to change. Little reference is made to dealing with coastal communities' initial exposure to marine resource degradation. Strengthening ecosystem health, banning destructive fishing practices and outlining legal procedures for lack of compliance do not appear to carry the same weight as development through capacity building, improving human health and education and providing economic means to continue fishing, even fishing more intensively. This is perhaps not surprising given that adaptive capacity is the aspect of vulnerability most amenable to influence through policy interventions (Cinner et al. 2013). Furthermore, reducing exposure to resource degradation may require action at the international level (e.g. by reducing greenhouse gas emissions) or thinking outside the conventional-policy box by supporting livelihoods that do not depend on marine resources. Although these measures provide opportunities for reducing sensitivity and increasing the adaptive capacity of coastal communities to marine resource degradation, there are two consequences of pushing 'exposure' further down the agenda of the policy framework.

First, moving forward with measures to build adaptive capacity and reduce sensitivity without addressing exposure is tantamount to treating ill-health by healing symptoms, not the underlying disease. The cracks in the CM-SES dam that lead to exposure risk are not simply cured by filling with cement. Instead, policy-makers and interventionists need to address the underlying pressures on CM-SES, origins of vulnerability emanating from multiple sources (Glaser et al. 2012a).

Second, by concentrating on intensification of marine resource exploitation, development and economic progress (Sievanen et al. 2005; Ferse et al. 2012; Ferse et al. 2014), the policy framework, much like patron-client systems (Ferrol-Schulte et al. 2014), furthers the dependence on coastal and marine resources (Idrus 2009) and drives the decline of marine ecosystems to greater depths. The focus remains on increasing productivity in order to meet the production goals. Rather than using integrated, participatory approaches to reduce coastal and marine resource dependence (Cullen 2007; Salayo et al. 2012), the policy framework pushes its coastal communities towards new avenues of exploitation and opportunity – all within an already-stressed CM-SES. This leads to an imbalance in interventions that can effectively tackle the issue of coastal community vulnerability.

Livelihood diversification as an adaptive capacity measure has been identified as a key approach to reduce vulnerability (Ellis 1998; Cinner and Bodin 2010), but is not explicitly addressed in any of the policies found, apart from expansion into aquaculture. In no legislation was there any mention of strategies to find opportunities for livelihood diversification outside of the CM-SES. Assisted migration away from small islands and coastal areas particularly dependent on marine resources, which has been identified as a key policy action to address all three aspects of vulnerability (Cinner et al. 2012) and recommended in the Indonesian context by Ferse et al. (Ferse et al. 2012), was not found to be considered in the policies examined.

The current general development strategy and legal system hamper cross-sectoral and integrated approaches. Although jargon such as 'sustainable development' and 'integrated coastal management' has been adopted for decades in Indonesian policy, the focus remains on economic growth and development, rather than on integrated coastal zone management and true, long-term sustainability and resilience. In terms of the legal system, even in the Coastal and Small Islands Management Act, regulations deal more with the marine system rather than striving for a balance between aquatic and terrestrial parts of the coast. Policies, although employing terms such as integrated management and 'intersectoral' (in the case of Law 1/2014), remain sector-based, e.g. fisheries policy is focused on

capture and aquaculture. Given these shortcomings, comprehensive, integrated management and alternative livelihoods development (outside of aquatic resource use) remain elusive.

Limitations

There are limitations to this research: a lack of access to the grey literature meant that the analysis was restricted to what was available in the public domain. The focus of this review on the national level says little about the local realities. The aim was to highlight the gaps in addressing vulnerability for policy- and decision-makers and to help practitioners identify legal sources of strength in their interventions. The assumption of deducting priority from the number of legislative measures making use of particular types of interventions is a crude approximation meant to provide an orientation on what kind of approaches prevail. Differences in effectiveness and depth very likely exist between the various legislative measures considered here. It was not possible to discuss in detail the true depth or scope with which each piece of legislation deals with coastal issues relating to vulnerability. As a result, this paper does not draw conclusions on the relative effectiveness of each piece of legislation individually. Finally, the legal realm in Indonesia, despite being hindered by bureaucracy and complexity (Wever et al. 2012), changes constantly. What holds true today may not be the case tomorrow. The data set and analysis presented here is therefore not exhaustive, nor are the conclusions reached permanent.

Conclusion

In answer to the question of whether the policy framework provides an enabling context for addressing vulnerability of coastal communities in Indonesia: there is a definite lack of cohesion and balance in strategies to address the three pillars of vulnerability. So far it seems that the national policy framework has focused on addressing the symptoms (by outlining measures for dealing with sensitivity and adaptive capacity) without adequate consideration of one of the underlying causes of vulnerability (exposure). A more holistic and balanced approach needs to be taken if the Indonesian policy framework is to be appropriate and effective in addressing vulnerability of its coastal communities to marine resource degradation.

Table 3.3 Total mentions of interventions aimed at mitigating coastal livelihood vulnerability mentioned by Indonesian national policies (this list is may not be exhaustive)

Level	Year	Legislation No.	English name	Ban destructive practises	Strengthen Ecosystem Health	Strategies for coastal and/or fisheries management	Legal procedures for lack of compliance	Provisions for conducting aquaculture	Improved health or education	Assistance with intensification, capitalisation of existing fishing practises	Consider/enhance social and/or cultural assets	Call for capacity building	Community participation in management	Provision of credit systems	
Law	2004	31	Fisheries Act	x		x			x					x	
	2007	27	Coastal and Small Island Management Act	x		x	x		x		x	x			
	2009	45	Amendment to Fisheries Law			x	x	x							
	2014	1	Revision of Coastal and Small Island Management Act	x		x	x		x	x	x	x	x	x	
Government Regulation	2005	78	Managment of Outermost Small Islands		x							x			
	2007	60	Fishery Resource Conservation	x	x	x	x	x	x			x			
Ministerial Regulation	2008	16	Coastal and Small Island Management Planning		x				x			x	x		
		20	Use of Small Islands and Surrounding Waters		x										
	2009	01	Fisheries Management Areas of the Republic of Indonesia												
		05	Scale of Business in Aquaculture						x		x				

Level	Year	Legislation No.	English name	Ban destructive practises	Strengthen Ecosystem Health	Strategies for coastal and/or fisheries management	Legal procedures for lack of compliance	Provisions for conducting aquaculture	Improved health or education	Assistance with intensification, capitalisation of existing fishing practises	Consider/enhance social and/or cultural assets	Call for capacity building	Community participation in management	Provision of credit systems
		08	Empowerment and Participation in Coastal Areas and Small Islands						x		x	x		
	2010	12	Minapolitan			x			x	x		x		x
	2011	22	Guidelines for Distribution of Direct Aid in Marine Affairs and Fishery to Communities							x	x	x		x
	2012	18	Guidelines for Developing Master Plan of Minapolitan							x		x		x
		02	Guidelines for National Programme on Community Empowerment in Marine Affairs and Fisheries						x	x	x	x		x
	2013	04	Guidelines for Business Development in Fishing Communities					x		x		x		
		12	Management and control of the coastal area and small islands		x		x						x	

Level	Year	Legislation No.	English name	Ban destructive practises	Strengthen Ecosystem Health	Strategies for coastal and/or fisheries management	Legal procedures for lack of compliance	Provisions for conducting aquaculture	Improved health or education	Assistance with intensification, capitalisation of existing fishing practises	Consider/enhance social and/or cultural assets	Call for capacity building	Community participation in management	Provision of credit systems
	2001	33	Technical Directives for Utilization of Food Credits in the Marine and Fishery Sector						x	x				x
	2010	06	Fishing Gear in the Fisheries Management Areas of the Republic of Indonesia			x								
		22	Implementation Guidelines for Fisheries Credit System											x
Ministerial Decree	2011	18	Minropolitan Guidelines							x		x		
		56, 58, 83, 84, 85	Empowerment in the Marine and Fisheries Rural Business Development Framework of 2011											
	2012	50	National Action Plan for Prevention and Control of Illegal, Unreported and			x	x							

Level	Year	Legislation No.	English name	Ban destructive practises	Strengthen Ecosystem Health	Strategies for coastal and/or fisheries management	Legal procedures for lack of compliance	Provisions for conducting aquaculture	Improved health or education	Assistance with intensification, capitalisation of existing fishing practises	Consider/enhance social and/or cultural assets	Call for capacity building	Community participation in management	Provision of credit systems
			Unregulated Fishing											
	2013	37	Determination of protection status of Napoleon Fish (Chelinus undulatus)		x	x								
Total mentions				4	6	9	6	4	9	9	6	12	4	9

Chapter 4: Missing links: assessing the relationships between livelihood diversity and food insecurity in tropical coastal communities

Abstract: Coastal communities are often amongst the most vulnerable when it comes to food insecurity. Many coastal households, as well as conservation and development efforts, aim to improve food security through livelihood diversification. Yet little research has been carried out to assess whether food security, in terms of amount and diversity of diet, is truly improved by such strategies. This research asks whether livelihood diversity is related to food security in tropical coastal communities, and whether or not the same factors can be related to food security in two different regions. Surveys were carried out with fishermen in the Spermonde Archipelago in Indonesia and on Zanzibar, Tanzania during the rainy season. Surveys focused on diversity in livelihood strategies, household-level debt, material style of life (MSL) and one-day dietary recalls. The findings show that food security may be related to MSL and debt only in Zanzibar, but otherwise no significant relationships were found to the number of livelihoods in either research location. However different drivers of vulnerability to food security in each site may be responsible for the different degree to which the variables chosen can be related to food security in coastal households. For conservation and development efforts, this research highlights the need for careful consideration of locally relevant mechanisms that can contribute to or mitigate vulnerability.

Keywords: livelihood diversity, food security, coastal communities, vulnerability, sustainable livelihoods approach, small-scale fisheries

Introduction

Vulnerability in small-scale fisheries

In a world where environmental conditions and socio-economic dynamics are becoming increasingly unpredictable, it is necessary to consider which ecological and social systems will be threatened by local and global shocks and trends, and how. In the context of climate and institutional change, small island developing states (SIDS) fisheries are considered some of the most vulnerable (Guillotreau et al. 2012), mostly due to their direct and indirect dependence on marine natural resources (Béné 2006; Hughes et al. 2012a). For small-scale fisheries-based livelihoods, the effects of climate variability on catch, stock productivity and distribution can spell disaster for financial and food security. Indeed, countries most vulnerable to climate change are often also most food insecure (Krishnamurthy et al. 2014). Vulnerability entails 3 aspects: exposure, sensitivity and adaptive capacity (Adger 2006; Folke 2006; Gallopín 2006; McClanahan and Cinner 2011). For Chambers, a definition of vulnerability is the “exposure to contingencies and stress, and difficulty in coping with them. Vulnerability thus has two sides: an external side of risks, shocks and stress to which an individual or household is subject, and an internal side which is defenceless, meaning a lack of means to cope without damaging loss”(Chambers 1989). This damaging loss ranges from the short- to the long-term, and coping strategies are often nutritionally, economically and environmentally unsustainable (Maxwell 1995; Ferse et al. 2014).

Food security in tropical coastal communities

According to the FAO’s World Food Summit Report (FAO 1996), populations are food secure when all people, at all times, have physical and economic access to sufficient, safe and nutritious food to meet their dietary needs and food preferences for an active and healthy lifestyle. Availability and access, as well as utilization in the form of household choices are key components of food security (Barrett 2010) with access (or entitlements) being the missing link, the lack of which leads to hunger, famine and starvation (Sen 1981). According to Sen, food insecurity arises not from a lack of food, but from a lack of access to food. Srinivasan and colleagues demonstrated that low-income and small island nations are most likely to be profoundly impacted by global marine catch losses as a result of their heavy dependence on marine resources for protein (Srinivasan et al. 2010). Poor access to resources is a key component of poverty, and in most cases food insecurity can be associated with chronic poverty as opposed to catastrophes and disasters (Barrett 2010).

Small-scale fisheries contribute significantly to food security in coastal communities, both directly and indirectly (Béné 2006; Hughes et al. 2012a). Marine resources are either consumed by fishing households or are involved in cash-based livelihoods that directly influence the financial resources of the households (Kawarazuka and Béné 2010; Daw et al. 2011; Cinner et al. 2013). By engaging in fishing or fish processing, households acquire a financial benefit from marine resources, allowing them to purchase food and contributing to their overall food and financial resources. Therefore in the context of high marine resource dependence in tropical coastal communities, food and financial resources cannot be considered separately (Daw et al. 2011).

For communities who depend heavily on marine natural resources, the continued functioning of those ecosystems is a matter of survival. Coastal and marine social-ecological systems (CM-SES) in many tropical coastal areas exhibit high marine resource dependence, population growth and ecological degradation. The unpredictable nature of marine natural resources and the ecosystems in which they are housed can mean that households diversify within the CM-SES by changing fishing gear or fishing

location. Ecological degradation and over-exploitation mean that many households choose to diversify their livelihoods in order to mitigate the negative effects that these threats can have on food security (Cinner and Bodin 2010; Ferse et al. 2012). Livelihood diversity can be pursued as a coping strategy in the short-term, or as a form of long-term adaptation (Malleret-King 2000; Wanyonyi et al. 2008). The degree of dependence on the coastal and marine ecosystem can influence whether or not households are willing and able to resort to alternative measures once these ecosystems can no longer fulfil their basic needs (Cinner et al. 2009b; Daw et al. 2012). When it comes to mitigating vulnerability, such strategies are useful in the short-term but mean that households continue to rely on the CM-SES and push already-stressed ecosystems into further states of degradation and decline (Ferse et al. 2014). Diversifying away from the CM-SES into activities such as farming, informal labour and paid employment inside and outside the CM-SES, however, can require substantial financial, human, social and physical capital that may not be readily available to impoverished, vulnerable households (Nunan 2010). The betterment of food security through increasing livelihood diversity is a common strategy of many non-governmental organizations including the FAO, IFRC and USAID, yet few studies have analysed the deeper connections *between* the two. Although livelihood diversity may relieve the current tensions within the CM-SES, the possibility exists that such strategies merely shift vulnerability into new arenas. One example is the destruction of mangroves for the implementation of aquaculture schemes (Primavera 2004).

This article addresses two research questions related to the vulnerability of tropical coastal communities as expressed by food security. Firstly, can livelihood diversity be related to food security in tropical coastal communities? And secondly, do the same factors relate to food security in 2 case study sites? The implications of the knowledge generated by asking these two questions are profound for conservation and development efforts. A previous study has shown that numerous positive outcomes for poverty alleviation associated with integrated projects, although often realised, tend to be short-term and rarely continue ex-post conservation-and-development endeavours (Gurney et al. 2014). This research will identify further linkages between conservation and development in order to tackle the trade-offs that are usually expected between ecosystem conservation and development. A deeper analysis of the links between food security and livelihood diversity is necessary to further appreciation of how complex these systems are and to contribute to the debate on whether livelihood diversification truly improves food security and contributes to poverty alleviation and environmental management. Understanding these linkages will help to identify priority areas and allow research and resources to be directed to where they can be most effective.

Methods

Sustainable Livelihoods Approach

The Sustainable Livelihoods Approach (SLA) has been used as a comprehensive framework for assessing vulnerability in coastal and marine social-ecological systems (Allison and Ellis 2001; Allison and Horemans 2006; Ferrol-Schulte et al. 2013; Ferrol-Schulte et al. 2014). The framework captures livelihood strategies and outcomes from a multi-sector and interdisciplinary perspective using a participatory approach. Households are evaluated based on the number and diversity of assets (natural, social, financial, physical and human) that they can mobilize within a vulnerability and policy context in order to perform livelihoods strategies (e.g. fishing) aimed at specific livelihood outcomes (e.g. food or income security). The livelihood strategies and outcomes in turn influence the assets to which a household has access and their position in the overall vulnerability and policy context.

Table 4.1 Description of variables

Factor	Type	Description
Enough food	Dependent	Responses to the 5 point Likert scale question “do you have enough to eat” Possible answers were: ‘always’, ‘mostly’, ‘sometimes’, ‘hardly’ and ‘never’.
Regularly eat vegetables	Dependent	“Regularly” was taken to mean that the respondent had eaten vegetables ≥ 3 times in the past week as per Arimond and Ruel 2004. Responses in binary form “yes” and “no”.
Food security level	Dependent	The answers to the above two factors were categorised into a 4-point scale of food security. Responses to Enough food were given a score of 3 for always and mostly, 2 for sometimes, 1 for hardly and 0 for never. If the response to Regularly eat vegetables was positive, this was given a score of 1. Negative responses received a 0 score. The sum of both scores forms a rank of 0-4, with 4 being the most and 0 being the least food secure.
Material Style of Life (MSL) level	Independent	Presence/absence of owned transport, household structures (roof, wall and floor material) and 24 furnishings to assess relative wealth, economic status and financial capital. The least expensive and/or technologically advanced structures and furnishings were given a score of 1. Each more expensive alternative was given a score of 2, 3 and so on. The total scores were then grouped into 4 categories 0-15 “low”, 16-25 “medium” and 26-35 “high” and 36+ “very high” MSL levels.
Debt	Independent	Respondents were asked if they were in debt (yes/no). Those in debt were asked whom they owed money to and what for. This information was then categorized into ‘long-term needs’ and ‘short-term needs’ as factors of short-term coping as opposed to long-term adaptive strategies for dealing with vulnerability. From this an categorical scale was created: 0=no debt, 1= short-term needs, 2=long term needs
Number of livelihoods	Independent	Total number of different livelihoods practiced by all members of one household.
Type of livelihoods	Independent	Practiced by one and/or all members of one household. One or more chosen from: fishing, farming, paid employment, gleaning, seaweed farming, trade, informal labour and other.

Research sites

Two different regions were surveyed in order to determine whether the same factors could be related to food security. Zanzibar, a semi-autonomous island off the Tanzania coast in East Africa and the Spermonde Archipelago, South Sulawesi, Indonesia were chosen as research sites. Both areas have been involved in the marine trade for coral reef products (Radjawali 2011; Thyresson et al. 2013) and are home to documented social networks, in particular patron-client networks, that heavily influence this trade, as well as the fishing households engaged in it (Deswandi 2010; Radjawali 2011). These social networks and the marine trade itself form the basis of marine resource-dependent livelihoods in both Zanzibar and Indonesia, making them important contributors to food security and therefore

important influences on fishing household vulnerability. On Zanzibar 3 villages were sampled: Kizimkazi Mkunguni, Paje and Nungwi. In the Spermonde Archipelago, 4 islands were sampled: Barrang Caddi, Kodingareng Lompo, Saugi and Laiya.

Sampling strategy

Both sites were sampled during the rainy season (Zanzibar: April-July, Indonesia: October-December). On Zanzibar, opportunistic sampling at landing sites was used to survey 225 fishermen as they returned from fishing trips. In Indonesia, due to the small size of the islands sampled, 118 fishermen were surveyed in their homes or at landing sites. Surveys lasted around 30 minutes focusing on a one-day dietary recall (Savy et al. 2007). Information was triangulated with focus groups on Zanzibar, and key informant interviews and overt participant observations on Zanzibar and in the Spermonde Archipelago.

Statistical analysis

Pearson's chi-squared tests were used to ascertain whether there were significant differences in responses to each of the variables between the two study sites by comparing the relative frequency of responses for each category. The ordinal variables in Table 4.1 were used as dependent variables and the categorical variable 'location' represented the independent variable. This step was carried out in order to determine whether it was necessary to conduct the next stage of statistical analysis for each site separately or whether the samples could be combined into a single analysis. A Fisher's exact test, unlike the Pearson's test, allows for a comparison of variables with ordinal scales where populations are comprised of less than 5 samples (Hammond 2014). The Fisher's exact test was used in the second stage of statistical analysis to test for a relationship between food security level and the other variables in Table 4.1. The food security variable was taken as the dependent variable and compared with the number of livelihoods, MSL level and debt.

Results

The first research question asked whether livelihood diversity is related to food security in tropical coastal communities. The second question asked whether the same factors are related to food security across the case study sites.

As shown below, there were significant differences between the two research locations, Zanzibar and the Spermonde Archipelago, for all variables included in this analysis (the χ^2 results can be found in the first table of each sub-section before the tabulated results of each Fisher's exact test). Therefore the Fisher's exact tests were carried out for each research site separately.

Food Security

The perception of having "always" having enough food was higher on Zanzibar (see Table 4.2) whereas the regular consumption of vegetables was higher in the Spermonde Archipelago (see Table 4.3). This resulted in the food security levels assigned to fishing households being slightly higher in the Spermonde Archipelago, with around 92% of fishing households being assigned in the 3-4 categories and only 85% of Zanzibari fishing households being assigned the same. Table 4.4 indicates that fishing households on Zanzibar had lower absolute food security than those in the Spermonde Archipelago.

Table 4.2 Pearson's chi square test results showing significant differences in perceptions of food sufficiency between research sites

Response	Zanzibar (%) n=225	Spermonde Archipelago (%) n=118	Combined (%) n=343
Always	69.3	31.6	56.4
Mostly	9.3	15.3	11.4
Sometimes	13.3	51.3	26.3
Hardly	5.3	1.7	4.1
Never	2.7	-	1.8

Pearson's $\chi^2=69.58, p=0.000$

Table 4.3 Pearson's chi square test results showing significant differences in regular consumption of vegetables between research sites

Regularly eat vegetables	Zanzibar (%) n=225	Spermonde Archipelago (%) n=118	Combined (%) n=343
Yes	60.9	86.4	30.3
No	39.1	13.6	69.7

Pearson's $\chi^2=23.92, p=0.000$

Table 4.4 Pearson's chi square test results showing significant differences in assigned food security levels between research sites

Food Security Level	Zanzibar (%) n=225	Spermonde Archipelago (%) n=118	Combined (%) n=343
0	1.8	-	1.2
1	3.5	1.7	2.9
2	10.2	5.9	8.7
3	32.9	53.3	39.9
4	51.6	39.0	47.2

Pearson's $\chi^2=15.38, p=0.004$

Number of livelihoods

The number of livelihoods was higher in Zanzibari fishing households, with most respondents stating that their household implemented 2 or 3 livelihood strategies (Mean 2.88 ± 1.17) (see Table 4.5). In contrast, in the Spermonde Archipelago, most fishing households used 1 or 2 livelihood strategies (Mean 1.89 ± 1.00). Responses indicated fishing households on Zanzibar tend to diversify more outside of the coastal/marine realm into farming (54.7%) in comparison to Indonesia (0.1%). In Indonesia fishing households exhibited heavier dependence on the coastal/marine realm, diversifying from fishing into trade (13.6%), gleaning (2.6%), paid employment (22.0%), informal labour (23.7%) or tourism (0.9%).

The Fisher's exact test results showed that there was a significant relationship between the number of livelihoods and the food security level for Zanzibar but not for the Spermonde Archipelago (see Tables 4.6 & 4.7).

Table 4.5 Pearson's chi square test results showing significant differences in number of livelihoods between research sites

Number of livelihoods	Zanzibar (%) n=225	Spermonde Archipelago (%) n=118	Combined (%) n=343
1	11.6	43.2	22.4
2	27.1	35.6	30.0
3	34.7	11.9	26.8
4	17.8	7.6	14.3
5	6.7	1.7	5.0
6	2.2	-	1.5

Pearson's $\chi^2=63.50, p=0.000$

Table 4.6 Fisher's exact test results comparing food security level and number of livelihoods for Zanzibar

Food Security Level	Number of Livelihoods						Total
	1	2	3	4	5	6	
0	0	2	0	1	0	1	4
1	2	4	1	1	0	0	8
2	4	6	9	3	1	0	23
3	15	18	23	12	6	0	74
4	5	31	45	23	8	4	116
Total	26	61	78	40	15	5	225

Fisher's exact test $p=0.043$

Table 4.7 Fisher's exact test results comparing food security level and number of livelihoods for Spermonde Archipelago

Food Security Level	Number of Livelihoods						Total
	1	2	3	4	5	6	
0	0	0	0	0	0	0	0
1	0	2	0	0	0	0	2
2	4	1	1	1	0	0	7
3	32	15	8	6	2	0	63
4	15	24	5	2	0	0	46
Total	51	42	14	9	2	0	118

Fisher's exact test $p=0.132$

MSL Level

The MSL levels were higher in the Spermonde Archipelago than in Zanzibar (see Table 4.6). Almost all households owned at least one mobile phone (81% on Zanzibar and 80% in the Spermonde Archipelago). For Zanzibar, the Fisher's exact test results show that there was MSL level was associated with food security level. This is in contrast to the Spermonde Archipelago where no significant relationship was found.

A secondary calculation was carried out where the sample was split into MSL levels and then the relationship between the food security level and livelihood diversity variable was analysed using a Fisher's exact test. The tests were carried out individually for each research location. There were no

significant relationships found between the food security level and the livelihood diversity variable within different MSL levels for each country.

Table 4.8 Pearson's chi square test results assessing differences in MSL level between research sites

MSL Level	Zanzibar (%) n=225	Spermonde Archipelago (%) n=118	Combined (%) n=343
0	45.8	-	30.0
1	33.3	5.9	23.9
2	16.9	32.3	22.2
3	4.0	61.2	23.9

$\chi^2=194.93, p=0.000$

Table 4.9 Fisher's exact test results comparing food security level and MSL level for Zanzibar

Food Security Level	MSL Level				Total
	0	1	2	3	
0	4	0	0	0	4
1	7	1	0	0	8
2	17	4	2	0	23
3	43	22	7	2	74
4	32	48	29	7	116
Total	103	75	38	9	225

Fisher's exact test $p=0.000$

Table 4.10 Fisher's exact test results comparing food security level and MSL level for Spermonde Archipelago

Food Security Level	MSL Level				Total
	0	1	2	3	
0	0	0	0	0	0
1	0	0	1	1	2
2	0	0	3	4	7
3	0	5	17	41	63
4	0	2	17	27	46
Total	0	7	38	73	118

Fisher's exact test $p=0.790$

Debt

More fishing households in the Spermonde Archipelago were in debt than those on Zanzibar (see Table 4.11), although the differences were not significant. On Zanzibar most debts were short-term for food (35.6% of respondents in debt), with the largest portion of money (46.7%) borrowed for food being owed to shops/neighbours. However, in Indonesia most debts were long-term, the largest percentage being for boats (13.6 %). In 36.4% of cases, money for boats was owed to patrons.

Table 4.11 Pearson's chi square test results assessing differences in fishing household debt between research sites

Debt	Zanzibar (%) n=225	Spermonde Archipelago (%) n=118	Combined (%) n=343
Yes	55.6	63.6	58.3
No	44.4	36.4	41.7

Pearson's $\chi^2=2.04$, $p=0.15$

The Fisher's exact test found that only for Zanzibar was there a significant relationship between the debt and food security level variables (see Table 4.12). For the Spermonde Archipelago debt was not associated with food security level (Table 4.13).

Table 4.12 Fisher's exact test results comparing food security level and debts for Zanzibar

Food security level	Debt		Total
	Yes	No	
0	0	4	4
1	3	5	8
2	4	19	23
3	32	42	74
4	61	55	116
Total	100	125	225

Fisher's exact test $p=0.007$

Table 4.13 Fisher's exact test results comparing food security level and debts for Spermonde Archipelago

Food security level	Debt		Total
	Yes	No	
0	0	0	0
1	1	1	2
2	1	6	7
3	25	38	63
4	16	30	46
Total	43	75	118

Fisher's exact test $p=0.596$

Discussion

Food security

The Pearson's chi-squared tests showed that there was a significant difference for each variable between both research locations, meaning that the second stage of analysis required separating the sample data for the two countries for each variable. Preliminary results showed that the assigned food security levels, compiled from data related to perceptions of amount of food and regular consumption of vegetables, were in the highest 2 categories for most fishing households. This is not surprising given that markets in Stone Town (Zanzibar) and Makassar (Indonesia) mean that basic staple foods such as rice, maize meal and vegetables are available almost all year round. Food insecurity does not

appear to manifest itself in its entirety in the forms investigated in this research but could still arise as a result of *inadequate* nutrition in terms of amounts of different food groups consumed. The perception of having enough food and regularly eating vegetables do not allow inferences to be made regarding the nutritional quality of what is actually consumed. Instead, food insecurity in terms of sufficiency may be result from poor access to (Sen 1981), availability of, and quality of food (Maxwell and Smith 1992; Barrett 2010), supporting the various theories that food insecurity arises not from lack of food, but lack of entitlements and access. For this research it means that the choice of variables used to determine food security may not be comprehensive enough to give a holistic view of food security in either region. However there are some valuable lessons to be learned.

Livelihood diversity

Apart from subsistence fishing, farming and gleaning, all other livelihoods captured generated some form of income that would enable vulnerable households to buffer their state of food insecurity by purchasing food elsewhere. The lack of relationship shows that livelihood diversity has different implications across CM-SES components. The fact that the number of livelihoods had no significant effect on the food security level variable for either Zanzibar or the Spermonde Archipelago is surprising at first sight, but may indicate the necessity of disaggregating the reasons behind livelihood diversification and its true impacts on food security. This study shows that livelihood diversity does not necessarily lead to improved food security (Gurney et al. 2014). Relating to Zanzibar, it is a larger island where coastal households are able to engage in farming as a secondary livelihood strategy to directly improve their food security. The islands of the Spermonde Archipelago are small and water-scarce (Schwerdtner Máñez et al. 2012), increasing the communities' dependence on the surrounding reefs and Makassar's markets for their food security and therefore perhaps explaining the lack of a significant relationship. In the surveyed sites in Indonesia, farming was not an option to buffer the effect of declining catches on household food security. Sites selected on Zanzibar were within 2 hours drive by public transport of the commercial capital Stone Town. In contrast, the islanders surveyed in the Spermonde Archipelago have to travel at considerable cost by private boat to Makassar or rely on traders to bring produce from markets at a higher cost and on an unreliable basis. This means that coastal communities have easier and more frequent access to food, markets and alternative employment opportunities on Zanzibar than in the Spermonde Archipelago. Yet why any or a combination of these factors does not lead to a significant relationship between the number of livelihoods and the food security level remains unclear and could result from the choice of variables or the type of analysis used.. Alternatively, access to markets may buffer the need for a diverse livelihood portfolio.

The proximity and access to markets and commercial centres plays a key role for livelihood diversity prospects and their effects on the local environment (Kramer et al. 2009; Kawarazuka and Béné 2010; Hardy et al. 2013). Although Stone Town functions very much as a hub of activity for the Zanzibari CM-SES, it has strong connections to mainland Tanzania and Kenya (even northern Mozambique) that provide coastal households with opportunities to diversify out of their immediately local CM-SES. This is in contrast to the Spermonde Archipelago where the journey to Makassar may not only be arduous for some of the more remote islands, but outright dangerous during bad weather. The opportunities to engage in livelihood strategies that do not continue or exacerbate household dependence on marine natural resources are, at least in comparison to Zanzibar, limited when not accounting for remittances.

Another explanation for a lack of a significant relationship between the number of livelihoods and the food security level of fishing households could lie in the fact that more livelihoods do not equate to

better livelihoods, for all or even for some (Fröcklin et al. 2012). Widening a household's livelihood portfolio does not necessarily lead to an improvement in food security or financial status. One needs to focus not only on the types of livelihoods coastal communities are engaged in, but also what functions those livelihoods are meant to fulfil and how secure (or sustainable) the different livelihood options are in the face of change.

MSL and debt

When considering household debts in the context of vulnerability, it is necessary to ask “who incurs the debt and what for?” The political economy of debt varied between the two research sites, with Zanzibari fishing households incurring debt to cover short-term costs of food. In contrast, in the Spermonde Archipelago, debt was a result of investment in a means of production in terms of fishing equipment and boats (Ferse et al. 2012). The functions of debt and consequences on food security therefore may differ substantially between sites and warrant further investigation. Moreover, in many tropical coastal communities, conjugal roles are clearly divided, with men still fulfilling the role of the breadwinner, whilst women are responsible for food security (Maxwell 1995; Kawarazuka and Béné 2010; Fröcklin et al. 2012).

The lack of relationship between MSL level and food security could have been caused by a number of factors. The presence/absence of household furnishings doesn't necessarily mean direct and single ownership. MSL provides a measure of social status within a community, but not necessarily a reliable measure of wealth. The choice of furnishings, which was adapted to local contexts, may not have been given the weightings that were locally relevant to how those furnishings related to food security in terms of inherent monetary value. Indeed, market prices may not reflect the relative utility of a possession. There is also the question of whether the items included in an MSL analysis perform the function of consumption smoothing (in the short-term) or act as collateral for long-term investment, either of which could explain the variance in significant results found between the two research locations. This study did not survey the use patterns of financial resources such as MSL items or debts. This is necessary to further deconstruct the relationship between food security and livelihood diversity in the vulnerability context of coastal communities.

Overall livelihood diversity is a double-edged knife – on the one hand offering a ‘way out’ of dependence on declining ecological systems but potentially throwing vulnerable households out of the frying pan and into the fire of debt, migration and risk. Within-system diversity is of course useless if tackling chronic poverty and slowing population growth are not at the centre of efforts to improve food security and reduce ecological degradation (Harris et al. 2012; Hardy et al. 2013). Models have shown that if too many demands are placed upon an ecosystem in the form of natural or anthropogenic stressors, that ecosystem will not be able to continue to fulfil the functions expected of it on an ongoing basis (Hardy 2013). Livelihood diversity may actually be an *expression* of vulnerability rather than a sign of household strength and capacity to cope with uncertainty. A study by Gurney et al. (2014) found that livelihood diversity increased whereas fisheries dependence decreased in integrated MPAs, and showed a reduction in well-being. For integrated marine conservation and development decision-makers and practitioners, it is important to assess which livelihoods contribute or entrench vulnerability, and how, over time. The effects of globalisation and other macro-economic trends mean strategies with successful implementation and benefits in the past may not lead to the same effects for everyone in the future.

Implications of findings for conservation and development

The mitigation of vulnerability in tropical coastal communities through conservation and development is a complex issue. Marine natural resource management can be used as a means to navigate the rough seas that await the most vulnerable human populations (McClanahan and Cinner 2011; Smith et al. 2013) – those whose very existence relies on a functioning and productive CM-SES (Glaser et al. 2012a). For example, closures that may allow over-exploited fauna populations to recover and that can even enhance the socio-economic well-being of fishers (Benbow et al. 2014) can nevertheless have serious short- and mid-term socio-economic consequences (Christie 2004). Limiting fisheries requires local support, not forgetting in some cases substantial cultural and behavioural changes, in order to provide long-term solutions to food insecurity for marine resource-dependent communities (Christie 2004; Clayton and Myers 2009; Foale et al. 2013). Measures that limit access to marine resources in marine-resource-dependent communities should only be implemented where vulnerability assessments show that there is enough flexibility, willingness and adaptive capacity to buffer the potentially detrimental effects on food security (Webb and Harinarayan 1999; Barrett 2010; McClanahan and Cinner 2011; Hughes et al. 2012a; Krishnamurthy et al. 2014). Otherwise, such measures are in danger of keeping vulnerable household in the poverty trap (Cinner 2011) and reinforcing the negative feedbacks of food insecurity (Barrett 2010).

There are trade-offs between conservation and development (Foale et al. 2013), all within a dynamic and unpredictable context. Development efforts should not assume that the CM-SES in which coastal communities exist is static. Food security is not stable. The system that defines whether households or communities are food insecure is constantly changing. According to Barrett (2010) the best way to tackle food insecurity is to address chronic poverty, be it through policies, employment or improving access to markets and sustainable development. The coping strategies used by many coastal communities in buffering food insecurity are often nutritionally, environmentally and economically unsustainable (Maxwell 1995), once again reinforcing the need for a long-term, holistic adaptive management approaches. Even aquaculture, which may be an effective tool for buffering price increases of marine resources, comes with a nutritional cost, as well as being financially out of reach for many of the poorest coastal households (Belton and Thilsted 2014). Such efforts are also not without often serious environmental and subsequent socio-economic consequences (Primavera 2004; Fröcklin et al. 2012). One must also consider how shocks and threats can influence the promoted alternatives within different groups of society in order to foster a deeper understanding of vulnerability in heterogeneous communities (Dilley and Boudreau 2001; Fabinyi et al. 2014). The multiple effects of various “unknowns” such as markets, disease, infrastructure and health environments on food security require an integrated approach to coastal community vulnerability (Kawarazuka and Béné 2010). Programs such as PHE (population, health & environment) are pioneering the way forward and celebrating successes for integrated conservation and development planning, whilst simultaneously addressing the ever-present issue of human population growth (Harris et al. 2012; Mohan and Shellard 2014).

It is important for both conservation and development that the dynamic and inter-linked nature of the CM-SES and vulnerability of the communities these efforts are aimed at be realized. In order to deconstruct the relationships between food security and livelihood diversity in a CM-SES vulnerability context, this research addressed two questions: 1) is livelihood diversity related to food security in tropical coastal communities and 2) are the same factors related to food security in 2 case study sites with different framing conditions? The findings show that livelihood diversity was not significantly related to food security across sites. The lack of a significant relationship between the number of

livelihoods and the food security level could indicate that the chosen variables did not encompass enough components of food security to achieve the aims of this research.

In terms of the second question, the results demonstrate that different factors are related to food security across regions, and to different degrees. The links between livelihood diversity and food security are varied, which is not surprising given that the two study locations differ greatly in biogeographical and socio-cultural context. More research into the potential links between development and conservation is needed, using a holistic approach to food security and recognizing that different groups will experience different types and degrees of vulnerability (Maxwell 1995). It would furthermore be useful to try to identify thresholds of vulnerability within these groups, respecting the precautionary principle, with regards to their exposure, sensitivity and capacity to adapt to chronic food insecurity (Guillotreau et al. 2012). This research shows that local contexts vary and therefore silver-bullet approaches or frameworks can end up doing more harm than good.

In both research sites it is recommended that scientists and decision-makers work together to integrate food security and sustainable fishing practices in national coastal and marine policy (Beddington et al. 2012) with flexibility to adapt such management techniques to local contexts, but realistic and achievable strategies for provision of the necessary resources (Ferrol-Schulte et al. 2015). In both cases, reducing the loss and waste of food within household food systems and improving food storage during excess supply should also be prioritised. Further research needs to be undertaken in order to understand more about what causes a food crisis (Beddington et al. 2012). Weather (Pet-Soede et al. 2001) and remoteness (Kramer et al. 2009) are of particular influence in SES where human communities are not only directly dependent upon marine natural resources but also lack suitable alternative strategies to fulfil basic daily needs. In addition, before marine conservation and/or development efforts proffer alternative livelihoods as a means to integrate marine natural resource management and poverty alleviation, it is important to assess which demographic groups are linked best to current and potential livelihood options and what gains and trade-offs such strategies already deliver, or might bring, for food security and the marine environment.

Limitations

There are limitations to this research. This study was unable to incorporate data on the health and/or nutritional status of respondents. The findings therefore cannot provide an entirely holistic perspective on food security. In addition, the two case study countries involved in the analysis display very different economic climates and so quantitative data on income or debt was not collected. Seasonality was not incorporated into data collection. The local challenges to food security differ between sites. On Zanzibar, the dry season means vegetables are more expensive. In Indonesia the same is true; however, because most vegetables come from the mainland, the wet season has more significant implications for food security as transport to the archipelago is frequently impeded due to bad weather (*S. Husain Paragay, pers.com*). The heterogeneity between sampled islands and villages alone could help to explain the observed differences between the two research sites.

Concluding remarks

Coastal and marine ecosystems across the world are being severely degraded by a mosaic of anthropogenic and natural effects (Tundi et al. 2005; United Nations Environment Programme 2006; United Nations General Assembly 2011). The degradation and subsequent loss of diversity and functions threaten the capacity to absorb disturbances and for regeneration, renewal and self-organization of the CM-SES (Folke 2006). CM-SES with lower diversity and impaired function are more susceptible to shocks that overpower their adaptive capacity, potentially resulting in transformations or regime shifts that can simultaneously increase the vulnerability of their associated social system components (Berkes and Folke 1998).

Two primary factors associated with human dependence on natural resources in developing countries are poverty and food insecurity (Ellis 1998), and the fact of growing coastal populations means that the demands placed on marine resources to mitigate these drivers are expected to increase. This begs the question whether marine resource dependence, which potentially increases the vulnerability of the CM-SES to shocks and trends, can also provide opportunities that can potentially mitigate the same. This research used the Sustainable Livelihoods Approach (Department for International Development 1999) as a point of departure for evaluating whether vulnerability within the CM-SES can be mitigated in a continuing context of marine resource dependency in coastal communities.

The Sustainable Livelihoods Approach is not without its limitations (Morse et al. 2009). Previous natural resource management and poverty alleviation strategies have shown that common challenges remain, as outlined in the first part of this thesis (**Chapter 1**). Mitigation of vulnerability requires an understanding of local contexts and interdisciplinary consultation to address tropical CM-SES management more effectively. The multi-level, multi-scale nature and complexity of CM-SESs means that not every obstacle to sustainability can be removed. In order to use realistic means to realize achievable goals, it is important to change the things one cannot accept, accept the things one cannot change, and search for the difference. Familiarization with the SLA provided the background for its implementation in an empirical analysis of patron-client relationships on Zanzibar (**Chapter 2**). The aim of this paper was to identify the structure and dynamics of marine resource dependence in coastal communities as influenced by patrons. The paper evaluated the role of patrons as institutions in determining marine resource dependence within the scope of the first and second sections of the SLA, the household asset base and the vulnerability context. Results showed that although patrons are often overlooked by CM-SES management, the functions they perform in coastal communities involve food and income security and provision of marine resource use infrastructure. Although these functions are often carried out by patrons, they can be assumed by cooperatives. Either way, patrons in their capacity as influential characters within coastal communities can either drive or alleviate pressure on MNR, contributing to the patron-focused works of previous studies (Rahman and Wahid 1992; Pelras 2000; Crona et al. 2010; Radjawali 2011; Ferse et al. 2012) and linking the findings back to the use of the SLA in CM-SES (Allison and Ellis 2001; Allison and Horemans 2006; Ferrol-Schulte et al. 2013).

Patrons are not, however, the only institutions with substantial influence on marine resource dependence in coastal communities. The policies and processes that encompass the vulnerability context within which coastal communities exist can foster environments that contribute to and enable or detract from and hinder vulnerability mitigation (Chambers 1989; Allison and Horemans 2006). In the Indonesian context, national policy on coastal vulnerability was shown to be heavily focused on the development of adaptive capacity (**Chapter 3**). Although this is a favourable strategy

(Krishnamurthy et al. 2014), elements of addressing vulnerability related to initial exposure to resource degradation or even promotion of ecological integrity and ecosystem function that linked to coastal vulnerability were lacking. The good intentions of policy-makers were undone by inconsistencies between the national policy documents and poor financial planning. In this case, the Indonesian policy framework on coastal vulnerability was shown to be based on a narrow and inconsistent approach to mitigating vulnerability in the CM-SES, highlighting the need for consistency, coherence and interdisciplinary perspectives in CM-SES management. The thesis finally addresses the remaining components of the SLA, livelihood strategies and outcomes, in the context of food security and livelihood diversity on Zanzibar and in Indonesia (**Chapter 4**). Incorporating the lessons learned in **Chapters 1-3**, this part of the thesis contributes empirical data to the discussion on whether livelihood diversity can be related significantly to food insecurity in marine resource-dependent coastal communities in either research location. The findings demonstrated no significant links between the number of livelihoods and the food security levels across both regions, even if on Zanzibar alone, material style of life and debt were significantly related to the assigned food security levels. The findings identify that food security is not necessarily an outcome of livelihood diversity. Therefore encouraging coastal communities away from marine resource dependence is not necessarily paramount to alleviating food insecurity or even poverty alleviation, even if direct pressure on the marine environment is assuaged. These findings lend support to an increasingly documented lesson (Fabinyi et al. 2014) for marine conservation and development efforts: that silver-bullet strategies to mitigate vulnerability may place the greater explanatory burden on marine resource dependence, but consideration must be given to the social, cultural and power considerations across levels and scales, as expressed in **Chapter 2**.

This thesis contributes to the ongoing body of research on vulnerability by furthering understanding of the structure, dynamics and implications of marine resource dependence in coastal communities. Global marine conservation and development efforts can benefit from the new knowledge produced here by embracing vulnerability as the integrated, interdisciplinary and intricate concept this research has shown it to be. The high resolution of the conclusions produced by this work as a result of the case study approach means that the findings are not necessarily widely applicable. However, many scholars advocate that the key to resilience in complex systems during times of change is diversity (Berkes and Seixas 2005). In terms of the diversity of social components within the CM-SESs central to this research, size does not matter. Diversity in coastal and marine natural systems is already accepted as being vital to ecosystem survival (Bellwood et al. 2004; Hughes et al. 2005). This thesis is a call for scientists, decision-makers and practitioners to adopt the same attitude to social systems. This means embracing unpredictability, diversity and change whilst moving away from assigning vulnerability and CM-SES into categorical boxes. There have been numerous attempts to attribute key characteristics of resilience to CM-SES (Berkes and Folke 1998; Walker et al. 2002; Anderies et al. 2004; Folke et al. 2005; Ostrom 2009). The interdependence of humans and the marine environment means that only by appreciating that a generic concept of resilience and vulnerability in CM-SES remains, and is likely to remain, undefined can sustainable and effective strategies for environmental and human betterment be identified and implemented.

Outlook

The findings in this thesis have profound implications for the scientific and management communities that focus on mitigating vulnerability in CM-SES. I hope that this thesis will inspire further scientific research and work in the following directions:

- Longitudinal studies into the continuing effects of tourism trade on Zanzibar on the CM-SES in terms of changes and threats to ecosystem health (catch sizes, species condition, abundance, diversity) and human well-being (education, healthcare, wealth as measured by spending behaviour, livelihood strategies and outcomes, social networks incl. patron-client relationships, communications infrastructure).
- Research into the potential alternatives to patrons and conditions under which such substitutions would prosper in terms of performing the functions as identified in **P2**.
- Comprehensive analyses of food insecurity by tracking the flow of food and income from different livelihood strategies to nutritional status of coastal communities across seasons.

For decision-makers, marine conservation and coastal community development managers, my hope is that in future their agendas will include the following:

- Being open to the consequences of corruption, rights and access allocation, lack of local financial, intellectual and innovative capacity, and centralized governance for setting realistic and achievable goals in managing CM-SES.
- Addressing the potentially exploitative aspects of and offering alternatives to patron-client relationships.
- Fostering a holistic approach to mitigating vulnerability that includes addressing exposure and sensitivity, not forgetting environmental management, as well as development and adaptive capacity. In this way, the status of such projects can be elevated from ideas and concepts to effect a real change for the better.

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Eidesstattliche Erklärung

Gemäß §6 der Promotionsordnung der Universität Bremen für die mathematischen, natur- und ingenieurwissenschaftlichen Fachbereiche vom 14. März 2007 versichere ich, dass die vorliegende Arbeit mit dem Titel

*“Vulnerability and marine resource-dependence in
coastal and marine social-ecological systems”*

1. ohne unerlaubte fremde Hilfe selbstständig verfasst und geschrieben wurde
2. keine anderen als die angegebenen Quellen und Hilfsmittel benutzt wurden
3. die den benutzten Werken wörtlich oder inhaltlich entnommenen Stellen als solche kenntlich gemacht wurden
4. es sich bei den von mir abgegebenen Arbeiten um 3 identische Exemplare handelt.

Bremen, 05. Februar 2015

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