

University of Wollongong

Research Online

Faculty of Law, Humanities and the Arts -
Papers (Archive)

Faculty of Arts, Social Sciences & Humanities

January 2019

Evaluating the Fit of Co-management for Small-Scale Fisheries Governance in Timor-Leste

Alexander Tilley
WorldFish Centre

Kimberley J. Hunnam
Charles Darwin University

David J. Mills
WorldFish Centre

Dirk J. Steenbergen
University of Wollongong, dirks@uow.edu.au

Hugh Govan
University of the South Pacific

See next page for additional authors

Follow this and additional works at: <https://ro.uow.edu.au/lhapapers>

Research Online is the open access institutional repository for the University of Wollongong. For further information contact the UOW Library: research-pubs@uow.edu.au

Evaluating the Fit of Co-management for Small-Scale Fisheries Governance in Timor-Leste

Abstract

Fisheries co-management is an increasingly globalized concept, and a cornerstone of the Voluntary Guidelines for Securing Sustainable Small-scale Fisheries in the Context of Food Security and Poverty Eradication, adopted by the United Nations Food and Agriculture Organization member states in 2014. Timor-Leste is a politically young country in the relatively rare position of having underexploited fisheries in some areas that can be leveraged to improve coastal livelihood outcomes and food and nutrition security. The collaborative and decentralized characteristics of co-management appeal to policymakers in Timor-Leste with provisions for co-management and customary laws applied to resource use were incorporated into state law in 2004 and again reinforced in 2012 revisions. The first fisheries co-management pilots have commenced where management arrangements have been codified through tara bandu, a process of setting local laws built around ritual practice that prohibits nominated activities under threat of spiritual and material sanctions. To date, however, there has been little critical evaluation of the suitability or potential effectiveness of co-management or tara bandu in the Timor-Leste fisheries context. To address this gap, we adapted the interactive governance framework to review the ecological, social and governance characteristics of Timor-Leste's fisheries to explore whether co-management offers a valid and viable resource governance model. We present two co-management case studies and examine how they were established, who was involved, the local institutional structures, and the fisheries governance challenges they sought to address.

Publication Details

Tilley, A., Hunnam, K. J., Mills, D. J., Steenbergen, D. J., Govan, H., Alonso-Poblacion, E., Roscher, M., Pereira, M., Rodrigues, P., Amador, T., Duarte, A., Gomes, M. & Cohen, P. J. (2019). Evaluating the Fit of Co-management for Small-Scale Fisheries Governance in Timor-Leste. *Frontiers in Marine Science*, 6 392-1-392-17.

Authors

Alexander Tilley, Kimberley J. Hunnam, David J. Mills, Dirk J. Steenbergen, Hugh Govan, Enrique Alonso-Poblacion, Matthew Roscher, Mario Pereira, Pedro Rodrigues, Teresa Amador, Agustinha Duarte, Mario Gomes, and Philippa J. Cohen



Evaluating the Fit of Co-management for Small-Scale Fisheries Governance in Timor-Leste

Alexander Tilley^{1,2*}, Kimberley J. Hunnam^{3,4}, David J. Mills^{2,5}, Dirk J. Steenbergen⁶, Hugh Govan^{7,8}, Enrique Alonso-Poblacion⁹, Matthew Roscher², Mario Pereira¹, Pedro Rodrigues¹⁰, Teresa Amador¹¹, Agostinha Duarte¹, Mario Gomes¹ and Philippa J. Cohen^{2,5}

¹ WorldFish Timor-Leste, Dili, Timor-Leste, ² WorldFish (Malaysia), Penang, Malaysia, ³ Research Institute for the Environment and Livelihoods, Charles Darwin University, Darwin, NT, Australia, ⁴ Research School of Biology, The Australian National University, Canberra, ACT, Australia, ⁵ ARC Centre of Excellence for Coral Reef Studies, Townsville, QLD, Australia, ⁶ Australian National Centre for Ocean Resources and Security, University of Wollongong, Wollongong, NSW, Australia, ⁷ School of Government, Development and International Affairs, University of the South Pacific, Suva, Fiji, ⁸ Locally Managed Marine Area Network, Suva, Fiji, ⁹ Arthropology Lab, Madrid, Spain, ¹⁰ Ministry of Agriculture and Fisheries, Dili, Timor-Leste, ¹¹ Ecosphere Ltd., Lisbon, Portugal

OPEN ACCESS

Edited by:

Beatrice Irene Crona,
Royal Swedish Academy of Sciences,
Sweden

Reviewed by:

Brett W. Molony,
Oceans and Atmosphere,
Commonwealth Scientific
and Industrial Research Organisation
(CSIRO), Australia
Alan T. White,
Tetra Tech, United States

*Correspondence:

Alexander Tilley
alex.tilley@gmail.com

Specialty section:

This article was submitted to
Marine Fisheries, Aquaculture
and Living Resources,
a section of the journal
Frontiers in Marine Science

Received: 04 December 2018

Accepted: 24 June 2019

Published: 12 July 2019

Citation:

Tilley A, Hunnam KJ, Mills DJ,
Steenbergen DJ, Govan H,
Alonso-Poblacion E, Roscher M,
Pereira M, Rodrigues P, Amador T,
Duarte A, Gomes M and Cohen PJ
(2019) Evaluating the Fit
of Co-management for Small-Scale
Fisheries Governance in Timor-Leste.
Front. Mar. Sci. 6:392.
doi: 10.3389/fmars.2019.00392

Fisheries co-management is an increasingly globalized concept, and a cornerstone of the *Voluntary Guidelines for Securing Sustainable Small-scale Fisheries in the Context of Food Security and Poverty Eradication*, adopted by the United Nations Food and Agriculture Organization member states in 2014. Timor-Leste is a politically young country in the relatively rare position of having underexploited fisheries in some areas that can be leveraged to improve coastal livelihood outcomes and food and nutrition security. The collaborative and decentralized characteristics of co-management appeal to policymakers in Timor-Leste with provisions for co-management and customary laws applied to resource use were incorporated into state law in 2004 and again reinforced in 2012 revisions. The first fisheries co-management pilots have commenced where management arrangements have been codified through *tara bandu*, a process of setting local laws built around ritual practice that prohibits nominated activities under threat of spiritual and material sanctions. To date, however, there has been little critical evaluation of the suitability or potential effectiveness of co-management or *tara bandu* in the Timor-Leste fisheries context. To address this gap, we adapted the interactive governance framework to review the ecological, social and governance characteristics of Timor-Leste's fisheries to explore whether co-management offers a valid and viable resource governance model. We present two co-management case studies and examine how they were established, who was involved, the local institutional structures, and the fisheries governance challenges they sought to address. Despite their relative proximity, the two sites contrasted in local ecology and fishery type; community institutions were starkly different but equally strong; and one site had tangible economic benefits to justify compliance, where the other had marginal and anecdotal fishery gains. In our review of the broader governance landscape in Timor-Leste, we see co-management as a useful mechanism to govern small-scale fisheries, but there is a need to connect legitimized

local institutions with hierarchical governance of higher and external influences. Initial successes with implementing *tara bandu* incorporating a small marine closure have stimulated other communities to implement no-take zones – one universally popular but very limited interpretation of co-management. However, we highlight the need for a set of guiding principles to ensure legitimate community engagement, and avoid external appropriation that may reinforce marginalization of certain user groups or customary power hierarchies.

Keywords: customary marine tenure, tradition, community-based resource management, governance, legal pluralism

INTRODUCTION

The *Voluntary Guidelines for Securing Sustainable Small-scale Fisheries in the Context of Food Security and Poverty Eradication* (SSF Guidelines), developed to complement the 1995 FAO Code of Conduct for Responsible Fisheries, were approved by the Committee of Fisheries of the Food and Agriculture Organization of the UN (FAO) in 2014. This commitment provides unprecedented recognition of small-scale fisheries (SSF), which account for almost half of global fish landings utilized for domestic human consumption (FAO, 2018), and employ over 90% of the world's estimated 120 million fish workers (World Bank, 2012). The SSF Guidelines were developed in response to the increasing vulnerability of the economic, food security and nutritional benefits accrued from small-scale fisheries, particularly for many of the world's poorest and most marginalized people. The SSF Guidelines provide a range of high-level, but voluntary, commitments relating to human rights, fisher representation, economic and social development and sustainability. The challenge faced by countries now is the implementation of the SSF Guidelines, by way of aligning, adapting, reconfiguring and strengthening existing small-scale fisheries governance and management arrangements (Jentoft, 2014). This is particularly challenging in low-income countries where small-scale, multispecies fisheries are highly susceptible to governance and management failures (Gutiérrez et al., 2011).

Co-management has captured global attention as the most appropriate mechanism to manage tropical SSF. Fisheries co-management is defined as a relationship between a resource-user group (e.g., local fishers) and another entity (e.g., government agency or non-government organization) in which management responsibilities and authority are shared (Pomeroy and Berkes, 1997; Evans et al., 2011). The philosophy behind co-management is that those who are affected by management (e.g., fishers and other resource users) should be involved in making management decisions (Berkes, 2009), thereby improving the legitimacy of the state involvement in fisheries management through more inclusive and transparent decision-making processes (Evans et al., 2011). Co-management is well aligned to the commitments of participation, representation, collaboration and coordination (Evans et al., 2011; Wamukota et al., 2012) emphasized in the SSF Guidelines (Cohen et al., 2017). But, below these high-level principles are highly contextualized grounded

actions to effectively implement co-management in complex SSF systems (Young et al., 2018).

The degree to which responsibility is shared, and the form and function of co-management, varies by setting, depending on the nature of the fisheries, informal and formal governance institutions, and the capacity, influence and authority of nation-states and fishing communities (Sen and Nielsen, 1996). Much has been written about the evolution, role and performance of co-management in varying contexts in the Pacific island countries and territories (e.g., Govan, 2009; Davis and Ruddle, 2012; Jupiter et al., 2014; Klein et al., 2014) and in the Coral Triangle (e.g., Dirhamsyah, 2013; Cohen and Steenbergen, 2015). Whilst Timor-Leste falls within the Coral Triangle Region, its political and cultural history provides a new set of challenges and a valuable platform for learning.

This study represents the first account of co-management for Timor-Leste's SSF and our first objective is to describe the emergence and form that co-management has taken. Our second objective is to provide some critical reflections on the role of diverse actors and institutions in the implementation process, the sustainability of interventions, and the ongoing resourcing of SSF management in a developing country setting. By drawing on the interactive governance framework (*sensu* Chuenpagdee and Jentoft, 2013) we examine how the characteristics of small-scale fisheries (i.e., *system-to-be-governed*), in these two cases and in Timor-Leste more broadly, render them more or less governable using a co-management approach (*governing system*). We aim to unpack some of the particular challenges and opportunities that co-management might offer up as a principle vehicle with which to govern SSF in Timor-Leste and similar contexts.

MATERIALS AND METHODS

The Interactive Governance Framework (Chuenpagdee and Jentoft, 2013) breaks down the analysis of SSF into three main components: (1) System to be Governed, (2) Governing System, and (3) Governance Interactions. To describe the *system-to-be-governed* we briefly review both published and unpublished literature on Timor-Leste's SSF in terms of types and level of participation, the geographic range and focus of fleets, species targeted, and fishing gears employed. Second, to examine the *governing system*, we draw on previous reviews of the formal legal and policy instruments that have

enabled, or could potentially enable, state and municipal and village (*Suco*) levels of government to play a role in SSF governance. We also review published reports that explain how customary institutions have been proposed or invoked in community efforts to manage natural resources. Finally, we examine *governance interactions* to summarize the main co-management developments in Timor-Leste over the last two decades. We then delve into two cases where community-based forms of co-management have been implemented with support from external agencies. Data for these cases are drawn from published literature, and also from the first-hand experiences of authors who were facilitators in the co-management establishment processes in 2012 and 2015. These communities were revisited in late 2016 and again in early 2018 to evaluate how these approaches have fared in recent years. These visits used key informant interviews with fishers, traders and local leaders, and gender disaggregated focus group discussions (FGDs) to evaluate the longer-term effectiveness of the co-management regimes.

For each site we report the target fishery species using published analyses from the Timor-Leste national digital catch monitoring system, *PeskaAS* (including non-boat-based fishing landings), and utilize high resolution vessel monitoring data to characterize the distribution of fishing pressure across space between February 2018 and May 2019. Seven vessels in Adara and 15 vessels in Biacou were fitted with solar-powered boat trackers that record location every second. To classify fishing by range and habitat in each of the case study sites, fishing effort heat maps were created by segmenting the geography into a grid of hexagons, parsing individual trips into segments, categorizing these segments by activity (fishing vs. steaming vs. parking etc.) according to activity classification algorithms, and summing the total amount of fishing time (in hours) spent by the fleet in each grid cell.

RESULTS

System to Be Governed

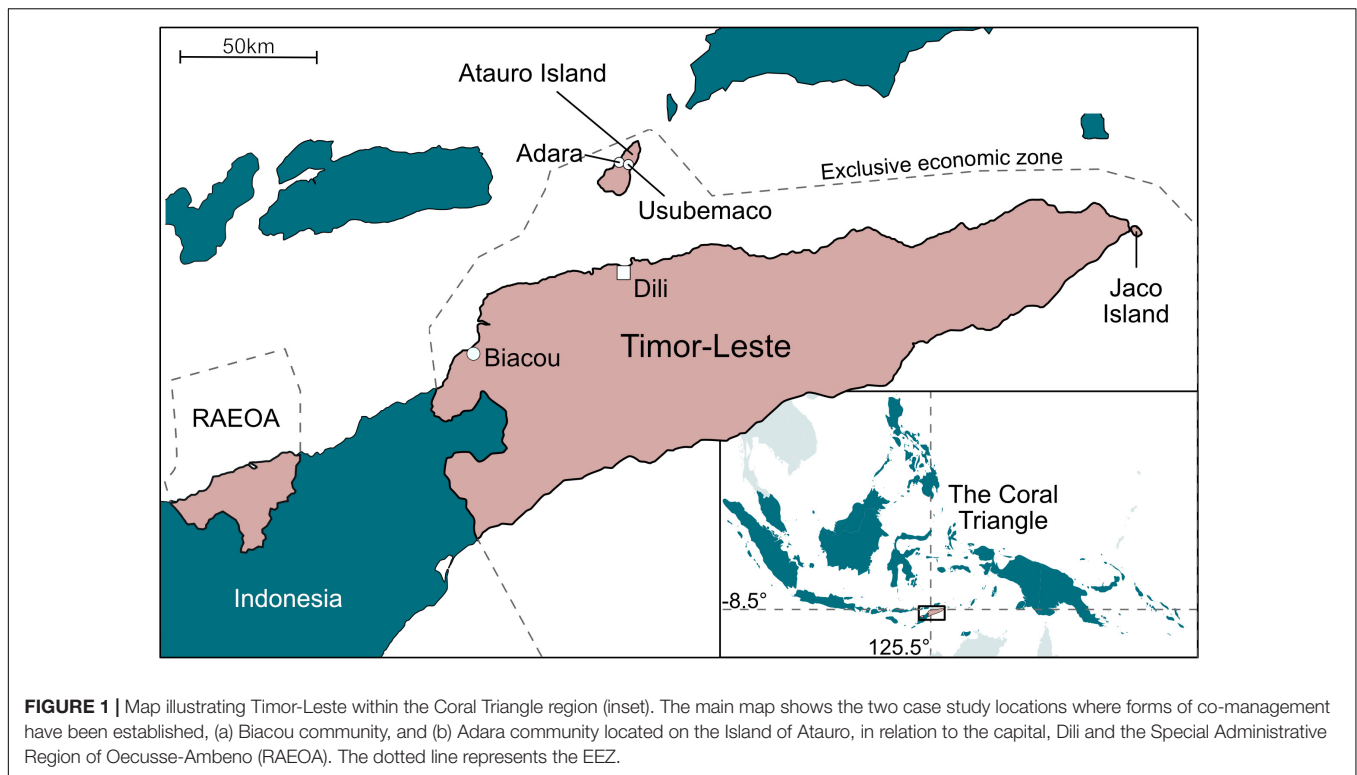
Timor-Leste makes up the eastern half of the island of Timor and has a population of approximately 1.2 million (GOTL, 2015). It was colonized by Portugal in the sixteenth century, and then following 9 days of independence in 1975, was annexed by Indonesia. The Democratic Republic of Timor-Leste was formed in 2002 following independence from Indonesia. The country has an extensive exclusive economic zone of 77,051 km² and a coastline of 706 km, which includes the Special Administrative Region of Oecusse-Ambeno (RAEOA), and the two islands of Atauro and Jaco (**Figure 1**). Following independence, the economy grew rapidly due to offshore oil and gas exploitation, the returns of which sit in a sovereign wealth fund and provide ~80% of the total budget for Government expenditure (World Bank, 2018). However, petroleum production is declining and few people are directly employed in the oil industry. In addition, levels of poverty, food insecurity and chronic malnutrition remain some of the highest in the world (Grebmer et al., 2015). With over 80%

of the population involved primarily in subsistence or small-scale agriculture and fisheries, and over 95% living in rural areas (GOTL, 2015), the sustainable enhancement of this sector is recognized as a priority pathway to building a more diverse economy (GOTL, 2011).

Recent figures suggest there are ~5000 fishers in Timor-Leste (GOTL, 2015), with over 2000 of these on the island of Atauro (Mills et al., 2017). The fisheries sector in Timor-Leste is almost exclusively small-scale, and in this context, small-scale fishing activities refer to those that take place on average less than 5km from shore, targeting reef fish and small, near-surface, open-water species such as sardines, mackerel scad, needlefish, garfish, and flying fish (López-Angarita et al., 2019). Fishing often serves as part of diverse livelihood strategies that simultaneously include agriculture, foraging, small-scale business and sporadic engagement in paid employment; each of which may become more or less important at different times of the year (Alonso Población, 2013; Mills et al., 2017).

The majority of boat-based fishing in Timor-Leste is done from one and two person non-motorized wooden outrigger canoes (82%). The remaining 18% consists of both slightly larger canoes with “long-tail” outboards (*katintin*) (63%) and larger wooden or fiberglass boats with outboard engines (35%) (AMSAT International, 2011b; Alonso Población, 2013). Following independence, foreign development assistance funded the distribution of approximately 300 outboard engines and 1,500 gill-nets to coastal fishers (Sanyu Consulting, 2003), conducted in part as a gear swap for beach seine fishing gear, which was banned. Gear types such as hand lines, spear guns, cast nets and monofilament gill nets, deployed from beaches, and across reef and seagrass habitats are simple and low-cost. Gill netting and hand-lining in and around river plumes target seasonally occurring schools of sardines, mackerels and scads. Seaweed farming and sea cucumber harvesting take place on seagrass beds (Park et al., 2012), while gleaning for molluscs, fish, crustaceans and cephalopods is common in the intertidal zone. Gleaning represents an important fishery livelihood undertaken predominantly by women and children for subsistence and/or sale (Sandlund et al., 2001; McWilliam, 2003; AMSAT International, 2011a; Alonso et al., 2012). In terms of landed weight and contribution to income, finfish are the most important group for fisheries livelihoods. However, gleaned catches contribute directly to household food and nutrition security, and to varying extent buffer the seasonal and stochastic nature of fisheries livelihoods (Tilley et al., in review).

Nearshore fish aggregating devices (FADs) are allowed by law and are commonly utilized by coastal fishers to increase access to denser schools of small pelagic fish. Fish around the FADs are targeted using hand lines, gill nets or seine nets known locally as *chinchin* and *lampoon* (Tilley et al., in review). Beach seine nets were banned after independence, but their use continues in areas where habitats are degraded or where fisheries productivity is low. Other highly destructive methods such as blast fishing and poisoning have all but ceased aside from localized use of naturally occurring, organic toxins in gleaning reef fisheries.



Small-scale fisheries play a crucial role in local food and nutrition security and livelihoods, and researchers suggest there is potential to enhance these contributions in Timor-Leste (Mills et al., 2013). Preliminary surveys from coral reef fishing grounds in Timor-Leste, however, suggest that mean fish sizes are small compared to neighboring sites in Indonesia (McCoy et al., 2015). Fisher surveys and focus groups in fishing communities across the north coast of Timor-Leste and Atauro Island also suggest declines in catch volume and fish sizes in reef fisheries, although there are no empirical time series data available to support this. Underwater visual surveys of reef fish biomass across Timor-Leste suggest healthy reef fish populations (López-Angarita et al., 2019). Both the case study sites examined in this paper have narrow fringing reefs, which provide limited fisheries productivity, but the country is in the relatively unique situation of having very lightly exploited stocks of small pelagic fish (Alonso et al., 2012; Mills et al., 2013). This underlines the need for fisheries management and diversification of fisheries to exploit more sustainable pelagic stocks, while simultaneously, addressing common concerns remaining about sustainability of nearshore marine resources for meeting subsistence needs, government-set nutrition goals, and conservation commitments (Alonso et al., 2012; NDFA, 2012; Mills et al., 2013).

Governing System

Fisheries governance in Timor-Leste involves two major governing systems: state-based institutions developed post-Independence, and community-specific customary institutions that have persisted and evolved through several hundred

years of Portuguese colonialism and 25 years of Indonesian administrative rule (Feijó, 2015). In view of this paper's scope we refer to state-based institutions (referred to as hierarchical governance by the Interactive Governance Framework) and custom-based governing institutions (referred to as self-governance by the Interactive Governance Framework), and how these two governing systems interact in co-governance or co-management which is, arguably, a newer and emerging governance system for fisheries in Timor-Leste.

State-Based Governance

Independence from Indonesia brought the need for Timor-Leste to develop its own fisheries laws and define sector priorities, providing the opportunity to promote a sustainable model of fisheries management (Alonso et al., 2012; Alonso-Población et al., 2016). Timor-Leste's constitution stipulates that "Everyone has the right to a humane, healthy, and ecologically balanced environment and the duty to protect it and improve it for the benefit of the future generations" (Article 61 n.º1). Whilst this recognizes a shared governing responsibility, the fisheries sector is formally (approved by Law Decree n.º14/2015, of 24 June) the governance responsibility of the Ministry of Agriculture and Fisheries (MAF).

Post-independence, a highly centralized governance system has developed and a mismatch between budget, bureaucratic processes and the requirements of municipalities are common (World Bank, 2012). The principle of decentralized public administration is clearly established in Timor-Leste's constitution (section 5), and over the past 15 years, government administrations have developed and adopted

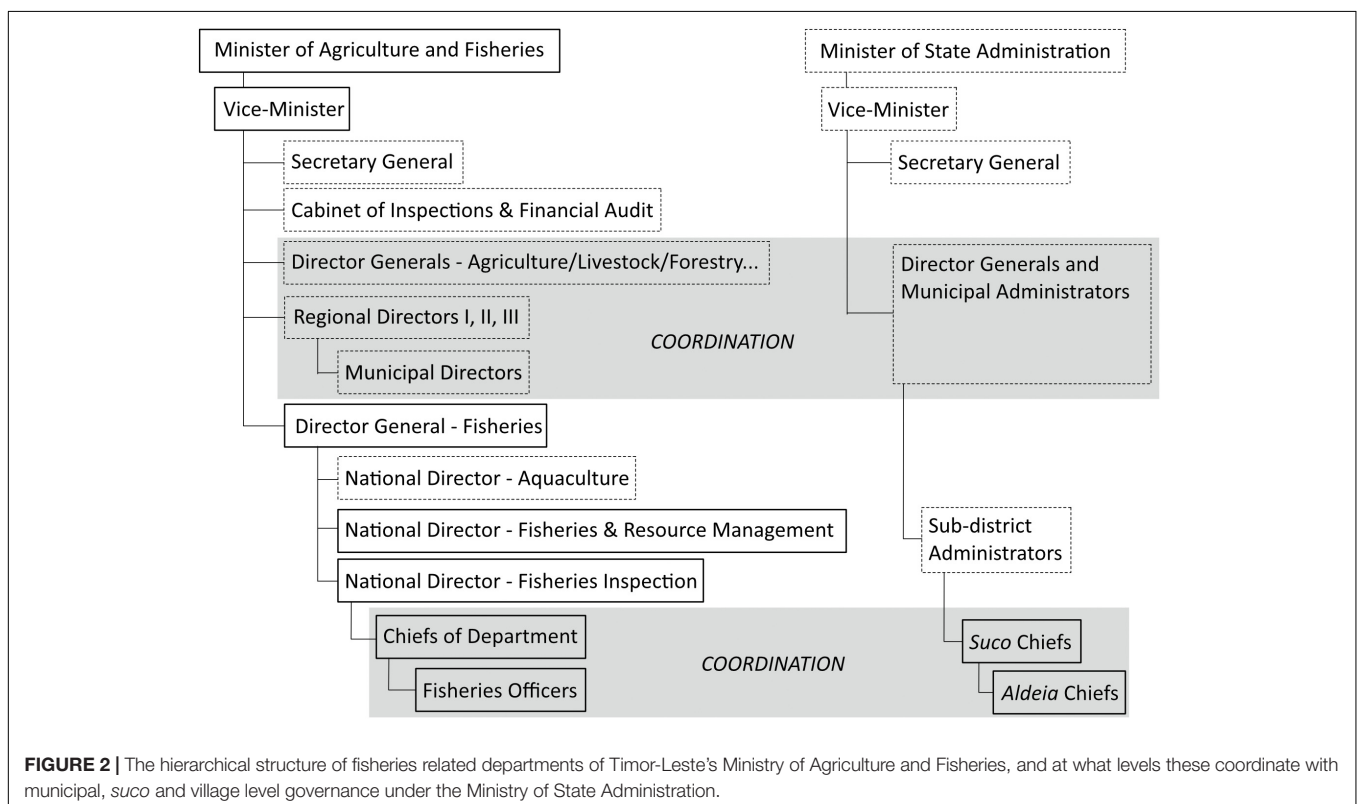
various decentralized governance frameworks, although none have yet been fully implemented (Cummins, 2015). In the most recent iteration, the Government approved Law-Decree n.º3/2016 (of 16 March) outlines a strategy of reform that will ultimately see the creation of a second, locally-elected, tier of government in each of Timor-Leste's 12 Municipalities (the 13th region of RAEOA is already given a degree of budgetary autonomy with Special Administrative status).

In the current structure of MAF, the Fisheries Department has a national office based in the capital Dili, and fisheries officers operate from MAF offices in each municipality. The national fisheries office is responsible for the monitoring of marine resources, collecting data and taxes on exports, administering boat licensing, and all enforcement and compliance including inspections of foreign licensed fishing vessels. There are 96 fisheries staff employed across 13 municipalities, some of whom work as community-based field officers who (depending on local levels of fishing and municipal resources available) typically include field extension activities like recording fish landings, training fisher and trader groups, and managing fish landing centers. These municipality-based fisheries officers play an important coordinating role with village and *suco* level leaders (Figure 2), and will be important actors in co-management as the link between the two hierarchies of governance, e.g., in escalating infractions outside the jurisdiction of local authorities or vision of co-management such as encroachment by industrial or foreign fishing vessels. In practice, the activities of both national and municipal fisheries departments and their influence over Timor-Leste's fisheries sector are limited due to low institutional, human

resource and financial capacities relative to the scale (number of fishers and fish traders) and scope (geographic expanse) of fisheries activities – particularly small-scale fisheries. For example, in 2017 the fisheries received only 0.07% of the national budget (López-Angarita et al., 2019). As stated by a MAF official, this “is not in proportion to the number of persons employed in rural activities, nor the number of people living with food insecurity in rural areas” (in da Cruz, 2016). Although, the number of staffs employed by MAF has increased substantially since early post-independence (from 350 people in 2002 to 2196 in 2015; da Cruz, 2016), the majority of the expansion has occurred in the agricultural sector.

Community-Based Institutions

The most relevant interpretation of “community” in Timor-Leste would relate to the geographical distribution of people in a *Suco* (village) and *aldeia* (hamlet), whereby several *aldeias* form a *Suco* (consistent with Miyazawa, 2013). While the composition of some *Sucos*, particularly in urban areas, has been altered due to colonial influence and migration, these communities are based on historical and cultural connections, linked to *uma lulik* or *uma lisan* (traditional “house group”) relationships established through kinship, marriage and alliance. It is suggested that *lisan* (customary law) is still the main source of law and authority for most Timorese people, particularly in rural areas (Cummins, 2015). It provides community cohesion and conflict resolution mechanisms, informs the allocation of leadership and decision-making power, and guides the use of communal resources (Cummins, 2015). This combination of customary governance



layered with state-based institutions has resulted in a current governance system described as political hybridity or a form of legal pluralism. It consists of two sets of institutions and laws, from very different worldviews, which community leaders must balance on a daily basis to ensure their decisions are legitimate and effective in their communities (Cummins, 2015).

Suco leadership has played an important role from before Portuguese colonization to the present. In recognition of this, provision for the election of a *Suco* council in each of Timor-Leste's 442 *Sucos* was first established in 2004 (Law n°5/2004, of 14 April), formally incorporating existing customary practices into state-based institutions (Cummins, 2015). In preparation for the creation of a Local Government at the Municipality level, the recently adopted *Suco* Law (Law n°9/2016, of 8 July 2016, pmbl.) refines the composition of the *Suco* council and takes further steps to legally affirm the "authority functions that are traditionally associated to [the *Suco*]." The *Suco* council is composed of community leaders elected by community members, as well as a *lia-na'in* (a customary authority figure who holds ritual and judicial powers) (Cummins, 2015), and encourages greater representation for women and young people through a formalized quota system¹. As outlined in the law, *Suco* councils and their leaders have a broad range of duties and responsibilities, including dissemination of state-based laws and regulations, and the promotion, adaptation or preservation of custom-based laws. However, actions may not be undertaken at the detriment of the State or Municipality tiers of government (Article 6).

Given their authority and responsibilities, *Suco* councils are critical points of engagement for both government and non-government organizations interested in carrying out community-based activities, including the establishment of new co-management committees or co-management arrangements for natural resources such as fisheries (Costa Pereira et al., 2013). The strength, priorities and perspectives of these local leaders (*Suco* and *Aldeia* chiefs) appear to be more important for successful resource management than an active and engaged district MAF fisheries officer.

While it has been suggested that Timorese people have less of a connection to the sea than other island nations (e.g., in the Pacific), local and traditional management and relationships with coastal resources do exist in parts of Timor-Leste. Despite being historically ignored or excluded by the Portuguese and Indonesian regimes, these institutions have persisted to varying degrees (McWilliam, 2003). *Tara bandu* refers broadly to laws or prohibitions (Hicks, 2004) that can be applied by communities to regulate land use or fisheries harvest in a given area for a set period of time (Shepherd, 2013). This may apply to, for example, prohibiting deforestation in terrestrial ecosystems (JICA, 2015), establishing temporal fishing bans in a freshwater lake (Needham et al., 2013), and banning the harvest of certain species or in specified coastal fishing areas (Alonso-Población et al., 2016, 2018). These custom-based laws are closely related to

cultural conceptualizations of the relationships between humans and non-human entities, and are complied with in part due to people's belief that if they break the rules, they will be cursed (Miyazawa, 2013). *Tara bandu* is enacted through a mix of diverse rituals leading to a usable regulatory practice of interactions within communities and between humans and their environment (McWilliam et al., 2014).

In the last 10 years, non-government organizations (NGOs) have initiated projects to re-introduce or strengthen *tara bandu* in various parts of Timor-Leste. Whilst it is often framed by NGOs as a longstanding and important tradition, *tara bandu* (as with other similar customary institutions e.g., Cohen and Steenbergen, 2015) has undergone a process of contemporary revitalization and re-imaging since independence (McWilliam et al., 2014; Alonso-Población et al., 2016, 2018). Observers have suggested that the application of *tara bandu* in managing natural resource use is merely appropriation of the institution to achieve externally formulated conservation and sustainability objectives (McWilliam et al., 2014), and its nature and presence in between governing systems reflects the presence of a legal pluralism (Alonso-Población et al., 2018). Nonetheless, *tara bandu* appears to hold legitimacy with communities, NGOs and government alike (see Table 1) and its invocation in community-based resource management or co-management seems almost inevitable. *Tara bandu* has played "an inherent part in the development of local ordinances to protect the forest-watershed areas" (MAFF, 2004, p38 in Miyazawa, 2013) and it has been suggested that it should form the basis of community-based fisheries management efforts (Needham et al., 2013). The MAF "has been encouraging the revival of *tara bandu* for both technical and political reasons" which are perceived as "benefiting both governmental authority and customary leaders" (Miyazawa, 2013).

Tara bandu is now also recognized by the state-based Environmental Framework Law (Article 8). This law affirms that *tara bandu* may be established through local common law to conserve the environment and promote the sustainable use of natural resources, and importantly, declares that the State will ensure the regulated area is effectively protected. More generally, the Constitution (Article 2 n.°4) affirms that "The State shall recognize and value the norms and customs of East Timor that are not contrary to the Constitution and to any legislation dealing specifically with customary law."

Co-management Policy Development Since Independence

The notion that state- and community-based management should be harmonized and interacting has had a degree of currency since independence. The various development of policies, regulations and programs in Timor-Leste related to fisheries co-management are summarized as a chronological timeline in Table 1.

Case Studies

Here we present two case studies of the development of fisheries management systems in contrasting settings. We have selected

¹The Council is composed by: the *Suco* Chief; the *aldeia* Chiefs of the *Suco*; a female delegate from each *Suco*'s *aldeias*; a male delegate from each *Suco*'s *aldeias*; a female youth representative from the *Suco*; a male youth representative from the *Suco* (Article 10, Law n.°9/2016, of 8 July 2016).

TABLE 1 | A timeline of fisheries co-management developments in Timor-Leste since 2000.

What	Year	Who	Description and co-management development	Comment
"Fish for the Future" – first national fisheries policy	2001	MAF	Focused on nascent state priorities such as staff capacity building, assertion of jurisdiction, and development of legislation (Alonso et al., 2012).	
Co-management or community-based, coastal resource management framework	2001	MAF under the World Bank's second Agriculture Rehabilitation Project	Detailed proposed community-based, coastal resource management scheme (Stockwell, 2001, 2002).	No follow up or implementation (Stockwell, 2002).
Law Decree 6/2004 of 21 April – establishes the general basis of the legal regime for fisheries and aquaculture management and regulation	2004	MAF	Provides for the creation of co-management committees with powers related inter alia to "compliance with conservation and management measures of fishing resources, protection of the marine environment, assistance in controlling illegal fishing and compliance with the fisheries legislation" (Article 114).	Currently under review (2018).
"Fish for Sustainability: Our Strategic Plan for Fisheries, 2006–2011" – a new fisheries strategy	2005 (drafted), 2007 (released)	MAF	To "encourage and facilitate community-based, fisheries management initiatives and aims at establishing a network of local, community-supported marine protected areas and encourage involvement of NGOs" (MAFF, 2005).	Not approved by the Council of Ministers, nor legally endorsed by the government (Alonso et al., 2012).
Development and establishment of Timor-Leste's first marine protected area, Nino Konis Santana National Park (NKSNP)	2006–2009	MAF in partnership with a consortium of Australian agencies	Project included a planning workshop for the NKSNP marine component which endorsed "a community-based approach to planning [. . .] – i.e., Locally Managed Marine Area (LMMA) model – to build local support, stewardship and provide for co-management" (Edyvane et al., 2009).	The adoption and implementation success of management process has not been critically assessed.
	2009–2013	USAID's Coral Triangle Support Partnership, implemented by Conservation International in partnership with MAF and a local NGO	The Indonesian National LMMA Network supported development and planning of LMMAs at Manatuto and Hera including exchange visits, community surveys and participatory planning in 2011–2012. Worked with communities of the NKSNP to identify priority resources and develop management solutions, leading to the development of a multiple-use marine park zoning and regulatory scheme, and community-based management plans (Weeks et al., 2014). As part of this work, a manual was produced on "Guidelines for Establishing Co-Management of Natural Resources in Timor-Leste" (Costa Pereira et al., 2013).	
Regional Fisheries Livelihoods Program for South and Southeast Asia (RFLP) – a regional program, implemented in six Asia-Pacific countries	2009–2013	Implemented by the FAO in close collaboration with the Timor-Leste Government, funded by the Kingdom of Spain.	Aimed at "strengthening capacity among participating small-scale fishing communities and their supporting institutions toward improved livelihoods and sustainable fisheries resources management," including the establishment and strengthening of co-management mechanisms (Needham et al., 2013). In Timor-Leste, the RFLP focused on building basic governance systems, such as the development of a National Fisheries Statistics System and a National Census of Fishers and Boats, among other activities. NDFA staff were also engaged to gather information from communities on informal management arrangements and governing mechanisms in coastal areas. Through this exercise the community of Biacou were identified as interested in re-enacting their <i>tara bandu</i> for management purposes.	Further details on the Biacou case study are provided below.
Participatory development of the first exclusively marine <i>tara bandu</i> in the community of Adara on Atauro Island	2015–2016	Implemented by WorldFish funded by the Australian Center for International Agricultural Research	A highly participatory approach involving all stakeholders in Adara, as well as relevant government agencies. Regulations, boundaries and fine structure were devised by the community, including a closed area with a "reef tax" for diving and snorkel groups wanting to enter.	Further details on the Adara case study are provided below.

(Continued)

TABLE 1 | Continued

What	Year	Who	Description and co-management development	Comment
National Fisheries Strategy	2017–2018	MAF and WorldFish funded by Norway and the Asian Development Bank.	Between 2017 and 2018, the DGP and WorldFish conducted national consultations with fishers in every municipality of Timor-Leste to inform the drafting of the NFS. The two primary strategic actions identified were (1) to update and harmonize the legal and regulatory frameworks of the sector; and (2) to develop an institutional framework conducive to participatory and transparent co-management of marine fisheries.	López-Angarita et al., 2019

these cases because they are the most mature examples of co-management in the country, and authors of this paper have been involved in the development of both cases. The first, Biacou, is on the mainland of Timor-Leste in a pelagic-focused fishery. The second is on Atauro Island, the most fish-dependent region of Timor-Leste (Mills et al., 2011), where reef fisheries are important, and supporting a developing stream of income from eco-tourism was a high priority for the community.

Case Study 1: Biacou Community

The *aldeia* of Biacou is situated in Bobonaro Municipality at the western end of Timor-Leste's north coast (**Figure 1**), some 23 km from the border with West Timor, Indonesia. Road access along the coast to Dili and inland to the Municipal capital, Maliana, is good and brings with it significant trade opportunities. Biacou is a hamlet of 100 households and 579 people (GOTL, 2015) and represents one of the most important fishery landing sites of the country in terms of landed weight per year (NDFA, 2016). Fishing is predominantly motorized with fishing taking place as far as 25 km from Biacou (**Figure 3**). Catch is dominated by small pelagic and semi-pelagic fishes such as moonfish (*Mene maculata*), sardines (*Sardinella* spp. and others) mackerel scad (*Rastrelliger* sp.) and flying fish (*Cypselurus* sp.) (López-Angarita et al., 2019). No stock assessment data exist for this area. Fishing is a major livelihood activity for most households, although livelihood portfolios are mixed and include agriculture, salt production and trade. The mean price for fish was ~USD \$2.80/kg with little variation between species at the time this study was carried out (Tilley et al., in review). In terms of local level authority, Biacou has an *aldeia* chief and is part of *Suco* Aidabaleten. The MAF office for Bobonaro Municipality is located inland, in Maliana, but a fishery officer is also based in Biacou community as a caretaker of the fisheries center (*Lote de peska*).

The community of Biacou recognized that they were facing environmental issues such as ongoing drought, deforestation and destruction of coral reefs for lime production, so they actively sought information and opportunities for outside help to design and declare a *tara bandu*. The Regional Fisheries Livelihoods Program for South and Southeast Asia supported the community in formally recognizing and instituting *tara bandu*, and using it as a means to strengthen marine resource management. This was seen as an invaluable opportunity to gain insights about implementation and longer-term enactment of principles of *tara bandu*. A detailed account of the process of establishing the

tara bandu in Biacou is given by Alonso-Población et al. (2016), who note:

“This *tara bandu* was not a measure imposed by the state institutions or by development agencies, although community leaders received external support during the process to establish the governance arrangement. Far from being an alien measure imposed anew, it represents an example of the revitalization of a customary practice and a claim for the assertion of land, coastal and marine rights, resource exploitation and management by the local community.”

Discussion of the Biacou *tara bandu* began in 2010 and it was enacted in August 2012. Discussions involved the formal (*Suco* chief, *aldeia* chief, National Directorate for Fisheries, and Aquaculture staff) and informal ritual authorities of the relevant origin house groups (*rai na'in kaer bua malus*), along with community members. The *tara bandu* rules and penalties were written in a public document signed by community representatives and witnesses, the places under protection were mapped, and a *tara bandu* map was painted on the wall of a public building. The final enactment of the *tara bandu* involved not only the aforementioned figures but also high-level political figures such as the Secretary of State for Fisheries and Aquaculture, who formally recognized the community's crucial role and authority in governing resources.

The *tara bandu* rules establish restrictions over the use of *lulik* (sacred, taboo) spaces, terrestrial resources (protection of forest resources, banning slash-and-burn agriculture) and marine resources (protecting coral, mangroves, prohibiting bomb and poison fishing, protecting turtles, and their eggs), and address conflict resolution (particularly between youth groups). It involves a three-step graduated penalty system, with second and third offenses giving rise to increasingly harsh penalties. In line with custom-based practice, penalties involve the offender providing food (goat, buffalo, rice), cash and other supplies (alcohol, cigarettes, betel nuts) to the community, which are consumed in a community feast once a reconciliation agreement has been reached. Payment of penalties to the community occurs after the offender admits to breaching the *tara bandu* rules and a stepwise reconciliation process. It is considered in the offender's interest to acknowledge their breach in the *tara bandu*; this rests upon the logic that by not holding the reconciliation ritual that re-establishes the *tara bandu*, offenders are punished by the spirits of the *rai na'in* or the ancestors, who are considered the ones enforcing the ban. Needham et al. (2013) recount the first enactment of the *tara bandu* penalties when a 100 years

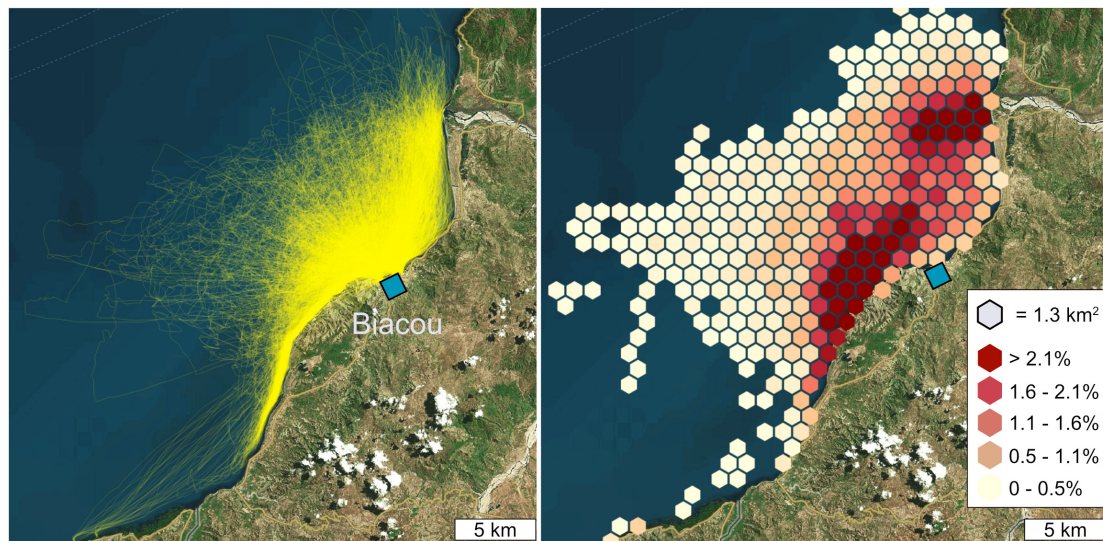


FIGURE 3 | Continuous tracking data and a fishing density heat map for 20 SSF vessels in Biacou from February 2018 to May 2019. The heat map color gradient is continuous and reflects the proportion of total fishing effort in hours for that hexagonal area. © Pelagic Data Systems. Satellite Imagery ESRI-Leaflet 2019.

old tamarind tree burned down. After the offense occurred, a community discussion and a conflict resolution procedure were held – locally called *nahe biti* (unroll the mat) (Babo-Soares, 2004) that involved both ritual and formal authorities, followed by a community feast and ritual to re-establish the ban.

In late 2016, men's and women's FGDs and key informant interviews with Biacou community members provided insights into the status and effectiveness of the *tara bandu*. Both groups stated that the *tara bandu* regulations were still effective and strictly enforced by the *aldeia* chief with the support of the MAF municipal officer at the fish landing center:

“Both men [the Chief & security guard] are regularly reminding people of the rules” (Women's FGD).

Others were also active in ensuring there was a broad understanding of the rules:

“Every point listed under the tara bandu has been enforced, and people follow them. The community, the local authorities and the rai na'in [spiritual ancestors] are making sure the rules are followed” (Men's FGD).

Both groups noted that “almost all” people in the community were happy with the application of *tara bandu* as it had increased their knowledge of marine resources, and had shown good results. Men and women from the community had integrated the *tara bandu* as a new cultural norm. There had been clear behavioral changes due to the regulations (agricultural practice, fishing locations, mangrove cutting) all of which would be expected to have positive dividends for the sustainability of natural systems. While anecdotal evidence from villagers suggested increases in vegetation on the surrounding hills, diversity of fauna in the mangrove systems and numbers of small fish, there are no empirical baseline data to test these assertions.

Importantly, and in contrast to the Adara case study below, there have been no direct/immediate financial returns from the formal declaration of the *tara bandu*. A key difference

between these cases is that there is no tourism in Biacou. However, people's participation in the declaration process, and interview and focus group responses, suggest that they value the formalized institution, and are convinced of its importance in securing the community's natural resource base. Given this, it seems highly likely that the regulations will continue to be active and effective into the foreseeable future. Indeed, there was considerable motivation to extend the *tara bandu* to other resources. Interestingly, on our return visit in 2018, men and women both highlighted that a ban on using gill nets in front of the mangrove area had had the biggest impact on their lives (both in terms of constraints and positive outcomes). This new rule, which was not included in the original *tara bandu* document of the community due to internal controversies between community members, reflects the adaptive nature of the *tara bandu* to accommodate new management measures as the need arises. The important role of the ritual authorities and mostly the *Aldeia* chief in socializing rules and enforcing the *tara bandu* was very clear, and continued success may be dependent on this strong and engaged leadership.

Case Study 2: Adara Community

The *aldeia* of Adara is located on the west coast of the island of Atauro (Figure 1). Adara is a hamlet of 98 households and 452 inhabitants (GOTL, 2015), and is accessible only by sea or by rough walking tracks across the island's central uplands. The steep topography inland of Adara and limited rainfall reduce horticultural activities to small hold farming. These conditions and year-round favorable seas have brought about a high dependence on fisheries livelihoods (Mills et al., 2017) that goes back many generations (Magalhaes, 1918; Barros Duarte, 1984). Yet, even self-identified fishers in Atauro pursue multiple livelihoods, complimenting fishing with limited crop and livestock farming or small businesses (Mills et al., 2017).

Livestock represents an important savings and investment mechanism, whereby any additional money accrued by the households from various livelihoods, will be invested in purchasing animals (AMSAT International, 2011a). The shallow water gill nets and close range spear guns utilized in Adara limit exploitation mainly to reef areas within 5 km range from the landing site (**Figure 4**). Reports from local fishers that catch rates have been declining in recent years are difficult to corroborate. Mean reef fish biomass of 2,207.8 kg/ha was the highest among five sites surveyed using underwater visual surveys in 2017 and 2018 (López-Angarita et al., 2019), which lies well above the range of reef fish biomass estimates from unfished reefs in the Indian Ocean (500–1800 kg/ha) (Graham and McClanahan, 2013) and is more than an order of magnitude higher than biomass seen on heavily fished reefs (MacNeil et al., 2015). Fishing is concentrated in the thin fringing reef areas and on the reef edge, and the catch assemblage is dominated by the small pelagic Carangidae (mackerels and scads) and reef dwelling fusiliers (Caesionidae) and soldierfishes (Holocentridae) (López-Angarita et al., 2019). The mean price for fish was ~USD \$1.81/kg with little variation between species at the time this research was carried out (Tilley et al., in review).

Despite its isolation, Adara is now a relatively popular dive and eco-tourism destination. Tourism efforts began in 1994 when simple beach cabanas were built by an Indonesian company, but only one or two tourists reportedly ever came. In the late 1990s and early 2000s, tourists in search of calmer snorkeling and diving beaches during the wet season started investigating Adara by walking overland from Usubemaco (the main dock of Atauro, where boats from Dili arrive). In 2010 and 2013 simple cabanas were constructed by a private tour operator

and community members, respectively. However, tourism did not increase significantly until 2013, following the release of a documentary about Adara (Alonso-Población et al., 2016), and the establishment of direct boat routes from Dili.

Considering the high vulnerability associated with specialized livelihoods, compounded by the perceived declines of reef resources and fisheries, Adara undertook a process to introduce community based resource management (CBRM). In 2013, the international research organization WorldFish began supporting the Adara community to develop fishery management plans and establish a locally managed marine area (LMMA) (Mills and Tilley, 2017); at the community's request, this was based on the *tara bandu* mechanism. Consultative processes were facilitated by the *aldeia* chief and overseen by a committee of men and women appointed by the Chief. As in the Biacou case study, a set of rules were drawn up to govern resource extraction across the entire area considered to be community fishing grounds, and a 0.04 km² area of reef directly in front of the community was permanently closed to all extractive activities. Critically, the location of this closed area was discussed in detail and agreed upon in women's focus groups, as women's gleaning activities would be displaced by the closed area. As in the Biacou example, rules were established that *tara bandu* violators would be fined a quantity of food items, with repeat offenders subject to a doubling and tripling of the fine quantities. The Adara community recognized and exploited the growing interest in Adara as an off-the-beaten-track tourist destination, and established a "reef tax" for snorkelers and divers entering the no-fishing zone. However, rules relating to ancestral spirits were not recognized since, in contrast to Biacou, Adara community members predominantly follow Protestant Christian beliefs, and traditional spirituality

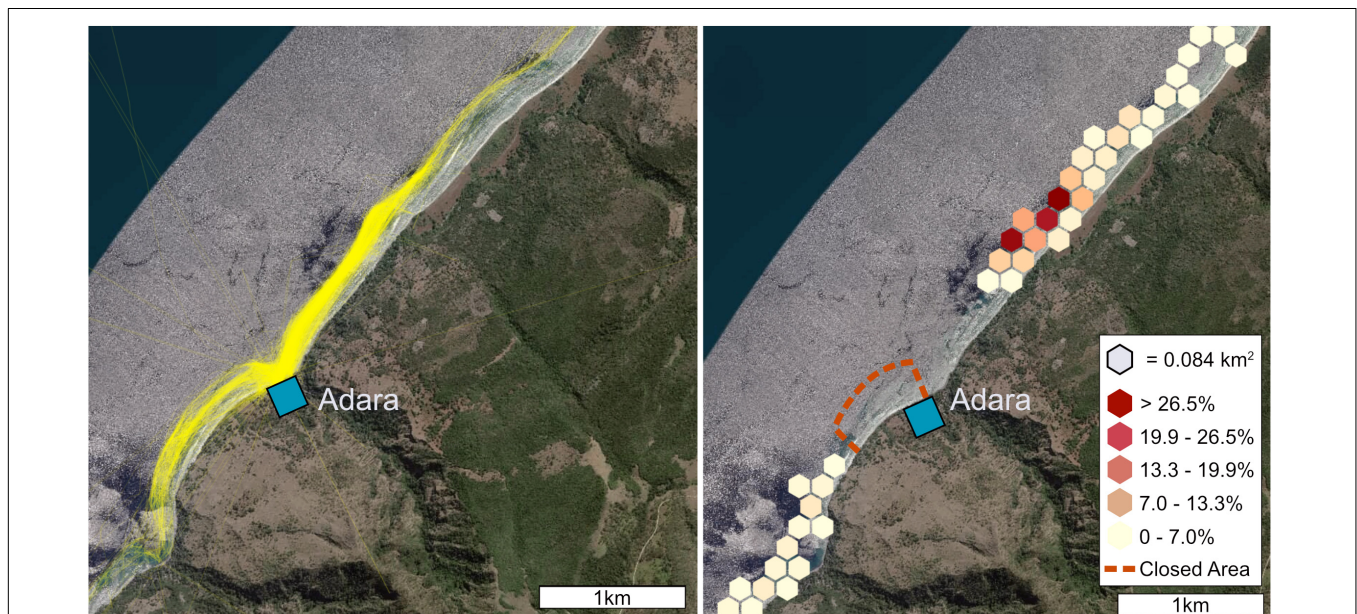


FIGURE 4 | Continuous tracking data and a fishing density heat map for seven SSF vessels in Adara from February 2018 to May 2019. The heat map color gradient is continuous and reflects the proportion of total fishing effort in hours for that hexagonal area. The red dotted line represents the closed area established in April 2016 as part of the *tara bandu* process. © Pelagic Data Systems. Satellite Imagery ESRI-Leaflet 2019.

and associated institutions have all but disappeared. Instead, the agreed rules were approved by the pastor and officially recognized by local government departments, with maritime police and administrative and *Suco* officials present at the opening ceremony in April 2016. Reef taxes contributed by tourists are accumulated and an elected committee of three community members (currently led by a woman) are responsible for their safekeeping until the community elects to publicly open the box, and vote on its usage for communal projects. Projects initiated after the first such ceremony were to develop the community's piped water infrastructure and set up a kindergarten.

When asked directly about what drove compliance to *tara bandu* regulations in Adara, community members stated that it was the church's recognition of the process (through their local pastor), and the tangible monetary benefit of having tourists visit the area. Adara provided the first example of *tara bandu* for marine resources on Atauro Island since before Indonesian occupation, and can arguably claim that their success is responsible for rekindling interest from many communities on the island in establishing LMMAs and a *tara bandu*. It represents a successful case in managing small-scale fisheries that can and has been expanded further afield, as compliance to regulations seems very strong with clear, direct benefits from tourism income.

DISCUSSION AND CONCLUSION

Coastal fisheries systems have seen a surge in investments and policy development toward the establishment of CBRM and LMMA sites, particularly in the Pacific region (Govan, 2009; Jupiter et al., 2014). However, as such systems of governance are increasingly promoted, there is growing recognition that coastal communities may not have the governing power to manage fishery resources against powerful external interests (e.g., Bailey and Zerner, 1992), for vulnerable species or fisheries of high economic value (Hamilton et al., 2019), or against the encroachment of "outsiders" into a particular groups fishing ground (Pomeroy et al., 2015) without government or legal backing. Additionally, while there is a need to uphold the diverse needs, interests and ritual attachments of fishers and fishing communities, mechanisms that support national-level agency to meet development aspirations, management responsibilities and compliance concerns must be considered. A potential solution to reconcile the national with the local interests lies in co-management, where the technical, governance and financial support from governments and or other external agencies are integrated with the knowledge, lived experience and legitimacy of local institutions in fishing communities (McWilliam, 2003).

Our case studies of coastal co-management in Timor-Leste suggest that, despite its relative infancy as a means to regulate marine resource use, co-management appears to be effective at engaging communities in resource management which can then contribute to multiple objectives of national governments, local communities and also those recognized in the SSF Guidelines in terms of accessibility and wellbeing. The way in which the process and ritual of *tara bandu* has led the development of co-management illustrates a meaningful interaction between

the customary and contemporary, and between innate and appropriated cultural practices for fisheries management, as has been shown elsewhere (e.g., Johannes, 1981; Foale and Manele, 2004; Cohen et al., 2012; Cohen and Steenbergen, 2015). In both case studies, the importance of strong community institutions is paramount, but their *raison d'être* and drivers of compliance differ significantly. We explore these drivers, and reflect on the suitability and sustainability of co-management for governing coastal fisheries in Timor-Leste.

Drivers of Compliance and Sustainability

The development of local marine management, while supported by external agencies in both case study communities, was driven by endogenous perceptions of need or the desire for change, or a perceived crisis with resource status. Prior to starting down the pathway toward co-management, community leaders had voiced concerns about the unsustainable use of resources. Both communities were guided through participatory processes that did not have pre-determined donor or government objectives linked to "recruiting" communities to a pre-defined management objective or model of management. Nonetheless, both communities ultimately codified a *tara bandu* agreement.

In Biacou, the belief in ancestral spirits as the enforcers of rules drives compliance. In contrast, in Protestant Adara the support of the church, and the very tangible returns from tourism taxes drove compliance. Success in community-based management systems may be attributed to social as well as ecological dimensions such as fostering a sense of stewardship and collective self-confidence (Murphree, 2009; Wamukota et al., 2012). Furthermore, communities may attribute bequest value to stewarding resources for future generations (O'Garra, 2009), as might be inferred from Biacou's desire to reverse perceived environmental declines. It appears that Adara's success and potential sustainability is largely driven by the opportunity to link resource protection to tourism revenue, and obtain financial returns to fund communal projects. This happens in a Protestant community who lived a particular conversion process by which beliefs in the *rai na'in* spirits and ancestors are not part of the contemporary belief system. There is evidence to suggest that ecological successes of co-management are felt by community members, and the recognition of the process by the Pastor is important, but compliance is predominantly driven by the tangible and rapid accrual of money from tourism to the closed area.

The history of attempts to encourage tourism in Adara implies the community was more aware of contemporary opportunities and we understood these communities to be more accustomed to external assistance, predisposing them to try new approaches such as co-management with an explicit goal of encouraging tourism. Certainly, the levying of a "reef tax" in Adara was a primary reason given for creating a co-management committee because this body would be needed to collect and safeguard the revenue. Yet, Adara and the island of Atauro are exceptions in terms of opportunities linked to tourism. In Timor-Leste, tourism is still in its infancy, with international visitor arrivals the lowest among Southeast Asian nations representing only 0.06% of international visitors in 2016 (UNWTO, 2017). The

potential for tourism to benefit local livelihoods is not high for most communities in Timor-Leste, especially on the mainland, with low visitation rates and high numbers of saltwater crocodiles (Brackhane et al., 2018) which directly inhibit the potential beach and dive tourism associated with the development of LMMAs. Nonetheless, even remote community sites on the mainland are excited by the economic promise of tourism (WorldFish, unpubl. data), and may mistakenly identify the implementation of *tara bandu* and closed areas as mechanisms to tap into this potential. Any form of tourism has its inherent vulnerability to political instability, global financial drivers (Sonmes, 1998), or as seen recently in Timor-Leste, fickle pricing behavior of airlines. These will also present new challenges and risks as community members become increasingly reliant on tourism to supplement incomes.

In contrast to Adara, the sustainability of Biacou's *tara bandu* is not reinforced by financial returns, but rather by an engaged leadership (both political and ritual), the firm belief that associated ancestral spirits (*rai na'in*) can resolve contemporary problems (i.e., the current presence of a particular cosmological order), and the belief that current problems arise from the longstanding disrespect for ritual practices (i.e., during Indonesian occupation). The social pressures and fear of ancestral spirits (*rai na'in*) appear to be the primary drivers of compliance. Benefits accrued from management in Biacou are far less tangible and slower than in Adara; although in Biacou some fishers anecdotally reported modest improvements to fisheries. In Biacou, rules were adapted to prohibit gill netting near the mangroves since the establishment of the *tara bandu*, which suggests not only that the legitimacy of the institution had not been eroded with time, but rather that regulations could be strengthened despite fewer quantifiable gains. The increasing education and westernization of youth in Timor-Leste may threaten the effectiveness of these spiritual sanctions in controlling behaviors in the longer term. In other cases, a combination of customary, religious and contemporary (through state law of the perception of illegality) institutions have been applied to bolster one with another (Cohen and Steenbergen, 2015). As contemporary pressures increase, and customary or local institutions (potentially) erode, the need for legal or governance bolstering from a relationship with the state (hierarchical governance) may well increase in Timor Leste, as has been observed in other countries.

Governance Mechanisms and Processes

The "Fishing for Sustainability" national strategy document developed for 2006–2011 may have narrowed the view of *tara bandu* by suggesting that "community-based fisheries management initiatives [should aim] at establishing a network of local, community-supported marine protected areas and encourage involvement of NGOs" (MAFF, 2005). Yet, a deeper understanding of *tara bandu* historically (e.g., Miyazawa, 2013; Shepherd, 2013) and in the context of these two cases, reinforces that *tara bandu* must not be deliberately or unintentionally confused as a *no-take zone*, or a method for one. Whilst the *tara bandu* CBRM mechanisms implemented in both our case studies have involved the spatial demarcation of fishing zones, only Adara incorporated a closed area for the specialized

purpose of protecting a diving area for reef tourists. *Tara bandu* can, and should, be considered as a form and process of local management plan, in being a set of agreed rules governing the use of resources. Importantly, as illustrated in depth in other studies (e.g., Miyazawa, 2013; Shepherd, 2013), *tara bandu* can act as a framework for appropriate participatory rule-setting around resources and behaviors; core elements of both co-management and implementing the SSF Guidelines. Area closures can form part of management planning where appropriate (i.e., where benefits from closures exceed the costs to fishers in terms of lost fishing grounds and lost opportunity to harvest). However, in most of coastal Timor-Leste, reefs are narrow so not supportive of high biomass, and the small pelagic species targeted by fishers (López-Angarita et al., 2019) are highly mobile, rendering a spatial closure meaningless. Other fisheries management mechanisms will be more appropriate and effective. In such instances, the participatory framework provided by the *tara bandu* mechanism may still be relevant as a tool for achieving co-management, but institutions that link local area management to greater spatial scales such as fisheries extension officers based in *sucos* (Figure 2), will be crucial to success.

Tara bandu should not be considered as the *only* appropriate mechanism for achieving successful SSF co-management in Timor-Leste. For example, some sardine fisheries in Timor-Leste are governed by rules implemented by traditional and *suco* level authorities, where they implement gear and size restrictions on other semi-pelagic fisheries in response to an oversupply of unmarketable fish (Hunnam, personal communication). In these instances, *tara bandu* is not invoked. This suggests there is clear potential to build SSF co-management on existing customary and local-level institutions where they exist. However, it should be at the discretion of the communities and actors involved whether such co-management mechanisms are underpinned by *tara bandu* ritual, or are transparent local-level management rules backed by formal authorities.

Both our case studies suggest that communities can effectively manage their local level behaviors and resource exploitation. However, this does not address concerns about the effectiveness of controlling the actions of outsiders who may not believe in the retributive punishment of ancestral spirits, and/or will not gain from associated monetary benefits. This is common to other Asian contexts where local compliance increases with CBRM development, but external or outsider non-compliance remains pervasive (e.g., Maliao et al., 2009; Nuon and Gallardo, 2011). Over time, this may lead to increases in conflicts which can erode the legitimacy of CBRM. To combat this, literature suggests developing CBRM networks at a wider spatial scale to foster cohesive management actions (Maliao et al., 2009; Gurney et al., 2014). This is an area where government can play *their* part in co-management, by responding to local or municipal level concerns of illegal or non-compliant fishing activities by outsiders as stipulated in Environmental Framework Law, Article 8 (the State will ensure the regulated area is effectively protected). In reality however, this relies on the General Directorate of Fisheries or the maritime authority being sufficiently resourced to do so, which is currently not the case.

The following section deals with the potential for partners in co-management to enhance broader compliance beyond the local community structures. We also discuss if the lack of continued support and follow up from government/NGO partners is actually co-management, or rather CBRM in the absence of decentralized governance.

Management Partners and Motives

Central to developing sustainable co-management systems, is a meaningful interaction between fishers and fishing communities and governing institutions at multiple scales (national, municipal, or *suco* level). In situations of limited fiscal and human resources relative to the scale and scope of SSF in Timor-Leste, external agencies such as the government, NGOs and development partners may find a legitimate role in attracting resources, facilitating management and design of institutions, and brokering new governance connections. However, building such connections within the dynamic and pluralistic governance structures of Timor-Leste will require careful design. Experience from the Pacific suggests that sustained transformations into CBRM are dependent on building the active support of communities (Abernethy et al., 2014; Blythe et al., 2017). Active support can be built by facilitating participatory scoping and awareness activities, tailoring or adapting rules to fit both local customary and contemporary practices, and engaging established governance structures or decision making processes that are already perceived as being legitimate (Abernethy et al., 2014). Deficiencies in the facilitation process used, such as not prioritizing gender considerations, not involving key stakeholders or not allowing adequate flexibility for community processes of consensus building, can drive rule-breaking and may greatly reduce the capacity of the local community to implement management plans or enforce the rules over outsiders as well (Pomeroy et al., 2015). In some instances, CBRM has actually led to increases in resource user conflicts (Clarke and Jupiter, 2010).

In the Solomon Islands, internal disputes and rule-breaking were higher at sites that received higher levels of support from international conservation NGOs, particularly in terms of management plan facilitation and environmental awareness, compared to sites in which communities had implemented fishery management rules with little or no outside NGO support (Abernethy et al., 2014; Pomeroy et al., 2015). Compliance and enforcement rates were reported to be higher at these latter sites. International NGOs have encouraged the equation by communities of taboos with MPAs to increase their local acceptability and likelihood of adoption. However, there are major differences in permanency, size, objectives, legal status, and design considerations between taboos and MPAs, meaning that sites designed as both may either not perform the ecological functions expected of them as MPAs or will not be sufficiently small or flexible to have minimal negative impacts on community life (Govan, 2009; Halpern et al., 2010). There is a risk that international NGOs will not ensure the best fit between local contexts and how co-management is enshrined in national policy or approaches (Rohe et al., 2017, 2019).

Our two case studies are, from our experience, relatively self-mobilized communities, but *tara bandu* processes were facilitated by external non-government actors. In parallel with experience in the Pacific (e.g., Léopold et al., 2013), development and conservation agencies in Timor-Leste have looked for opportunities for more effective interventions by drawing on existing, albeit eroded, traditions such as *tara bandu* (Shepherd, 2009). Such agencies may work to elicit the “right” behaviors derived from a world view often unaligned with local understandings (Shepherd, 2004) and at times in direct opposition to local needs – notably food and nutrition security. A thin veneer of participatory language may hide an approach that in reality is more akin to telling participants exactly how, and in what, they are to participate, and selling the potential gains to full participation. As such, the true extent of political will and self-mobilization can be hard to discern for anyone outside of these processes. *Tara bandu* revival has been actively endorsed and encouraged by NGOs and development partners in Timor-Leste since independence (Miyazawa, 2013), driven on the one hand by the desire to protect marine areas by conservation NGOs, and on the other by the need to build on local strengths given the insufficient financial or human capacity to enforce more formal top-down methods of management. The very small scale of fisheries and communities imply they are predisposed to being cohesive, with elected *suco* leaders, which may enhance their capacity to govern their resources in spite of complex and pluralistic rule structures.

The combination of *suco* level governance and ritual beliefs related to *tara bandu* compliments the responsibilities and duties allocated to the *suco* councils. *Suco* councils are intended to represent the interests of community members. However, given the hybridized nature of governance in Timor-Leste, they may simply reflect customary power hierarchies, and hence may reproduce and reinforce existing inequities. This “elite capture,” where control of resources by influential individuals reduces incomes and access rights of poor fishers (Khan et al., 2012), may be at play in Biacou, where “. . .three households belonging to Biacou’s founding lineage showed a disproportionately high fishing capacity. The community’s customary and administrative leadership at the time of research centered on these same households. While the average household boat ownership in Biacou was one boat per household, each of these households owned at least four boats” (Steenbergen et al., in review). In the same vein, the co-management committees provided for in Timor-Leste’s Fisheries Law Decree (6/2004, Article 114), may also merely reflect traditional village hierarchies. Governance decisions must rely on connections formed through the *Suco* council, but at the same time take into account community structure, power inequities and cultural nuances to avoid reinforcing elite capture.

Fishers are often the most vulnerable and marginalized people within a community, stuck in social-ecological traps where fishing is a last resort and high dependence can drive overexploitation (Cinner et al., 2008; Cinner, 2011; Cole et al., 2018). In these cases, the establishment of protected areas can exacerbate marginalization and poverty, especially amongst minorities (Christie, 2004; West et al., 2006;

Charles et al., 2016). Similarly, women's gleaning activities, which are often conducted close to communities when time is available between home duties, are particularly susceptible to exclusion through closed areas. Despite the small size of the closed area in the Adara case study (0.04 km²), this may still have had significant consequences on certain sectors of the fishery such as women gleaners, had they not been active participants in the design process. The promise of co-management is that by integrating voices from government and civil society (e.g., resource user groups, like fishers) in decision-making processes, the balancing of social and ecological sustainability objectives captured in the SSF Guidelines can be achieved.

The diverse nature of tropical reef fisheries implies they are among the most difficult to manage (Gutiérrez et al., 2011). Timor-Leste's SSF are predominantly non-mechanized and nearshore with limited large pelagic species targeted, making the focus of management very much on nearshore ecosystems. Land tenure, particularly the interaction of customary and contemporary tenure, is a work in progress in Timor-Leste. Customary marine tenure is even more loosely defined; boundaries may extend seaward from acknowledged land boundary markers (McWilliam, 2003) or relate to broad habitat types rather than to specific distances or geographical points. Ostrom (1990) highlighted the importance of clearly defined boundaries as a basis for co-management and this has been observed throughout the Pacific Islands, although such boundaries are often de facto, based on customary practice and not necessarily legally recognized (Govan, 2009). The important point is that resource managers (communities and government) are clear about which resources are being co-managed and therefore who the prime beneficiaries are. In Adara, in the absence of any formal enforcement by the government, the community takes it under their own authority to guard "their" resources against fishing by other communities on reefs and around fish FADs. The sustainability of co-management in these settings may rely on investment by government or external partners in recording traditionally recognized boundaries or locally acceptable marine extensions of the terrestrial *aldeia* and *Suco* boundaries (Alonso et al., 2012). The establishment and initial successes of the Adara LMMA has promoted the grass-roots growth of CBRM among Atauro Island communities. Other communities have since self-mobilized to establish SSF regulations and no-take LMMAs, or have reached out to NGOs for assistance with the co-management process. However, the converse is also occurring where well-resources external actors have used such initial success to aggressively push *tara bandu* as a mechanism to achieve externally derived objectives with insufficient resources or time given for local engagement, consultative gender-aware rule development, and understanding context. This emphasizes the need for knowledge exchange and the establishment of best practice, to strengthen the capacity and resilience of communities and leaders to engage with external agents and retain use rights (that enable stewardship), and strengthen the capacity of government to ensure legitimate process.

Effectively delivering the government contributions to co-management presents logistical challenges which may potentially be offset by decentralized institutional structures in Timor-Leste such as the municipal MAF offices (Figure 2). Decentralized approaches can enhance the resilience of the social-ecological system by being flexible and adaptive (Folke et al., 2005; Armitage et al., 2009) and can carry out simple and cost-effective co-management activities that support CBRM, such as identifying problems, facilitating lesson sharing between communities, facilitating agreement of rules, and sustaining community action (Govan et al., 2011; Govan, 2013). However, the capacity of Timor-Leste's government to structure and initiate decentralized environmental legislation is constrained by a lack of financial, technical and human resources, professional training and judiciary and public awareness of environmental laws. Furthermore, imposing an additional level of formalized governance onto the existing local institutional governance adds substantial complexity (Cummins and Leach, 2012), and it should be kept in mind that as governance becomes more decentralized, there is a risk that some people will be further marginalized or disadvantaged, due to potentially reinforcing local power hierarchies with formal governance.

In conclusion, the case-studies and analysis presented here suggest that self-governance persists in Timor-Leste and is implemented and relevant for fisheries management of nearshore coastal resources at limited scales, by building on locally legitimate institutions. Co-management can operate in Timor-Leste, by utilizing or interacting with these customary, legal and religious institutions of self-governance, while at the same time leveraging hierarchical governance mechanisms to manage larger scale fisheries challenges. Currently, the intermediary role of fisheries officers in escalating issues of (e.g.) outside encroachment is undefined, and the capacity for MAF to respond is very limited. *Tara bandu* is clearly a valuable institution for the development of local rules, and for facilitating engagement of resource owners and stakeholders in multi-scale governance, but must be supplemented by contextually-derived approaches and institutional architecture appropriate to managing important mobile fisheries resources (such as small pelagic species) at scales larger than community fishing areas. It is timely, following the example of Pacific countries, to design a set of best practices and principles to ensure legitimate community engagement (considering needs and aspirations, gender, and power inequities). These should be defined with some urgency and upheld by central government. The current reliance on external development partners and NGOs, while necessary, must be supplemented by a structured and well-coordinated program of capacity development that seeks to ensure sustainability of investments in governance and management.

AUTHOR CONTRIBUTIONS

AT, DM, and PC designed the study. AT analyzed the fisheries data. PC, AT, DM, AD, and MG were responsible for designing and implementing the data collection visits to the case-study sites.

AT, DM, MP, PR, KH, EA-P, MR, TA, AD, MG, DS, HG, and PC wrote sections of the manuscript.

FUNDING

This work was undertaken as part of the CGIAR Research Program on Fish Agri-Food Systems (FISH) led by WorldFish. The program is supported by contributors to the CGIAR Trust Fund. Funding support was provided by an Australian Centre for International Agricultural Research grant (FIS/2010/097) – *Exploring options for*

improving livelihoods and resource management in Timor-Leste's coastal communities and FAO “Fisheries co-management towards development impacts in Asia” (LOA/RAP/2017-39), and was implemented in close collaboration with the Ministry of Agriculture and Fisheries, Timor-Leste.

ACKNOWLEDGMENTS

We are very thankful for the patience and support we received from the community members who participated in this study.

REFERENCES

- Abernethy, K. E., Bodin, Ö., Olsson, P., Hilly, Z., and Schwarz, A. (2014). Two steps forward, two steps back: the role of innovation in transforming towards community-based marine resource management in Solomon Islands. *Glob. Environ. Change* 28, 309–321. doi: 10.1016/j.gloenvcha.2014.07.008
- Alonso, E., Wilson, C., Rodrigues, P., Pereira, M., and Griffiths, D. (2012). *Policy and Practice: Recommendations for Sustainable Fisheries Development in Timor-Leste*. Bangkok: Regional Fisheries Livelihoods Programme for South and Southeast Asia, doi: 10.13140/RG.2.1.1993.1608
- Alonso Población, E. (2013). Fisheries and food security in Timor-Leste: the effects of ritual meat exchanges and market chains on fishing. *Food Secur.* 5, 807–816. doi: 10.1007/s12571-013-0308-2
- Alonso-Población, E., Rodrigues, P., and Lee, R. U. (2016). “Tara Bandu as a coastal and marine resource management mechanism: a case study of Biacou, Timor-Leste,” in *Strengthening Organizations and Collective Action in Fisheries Towards the Formulation of a Capacity Development Programme*, eds S. V. Siar and D. C. Kalikoski (Rome: Food and Agriculture Organization), 301–340.
- Alonso-Población, E., Rodrigues, P., Wilson, C., Pereira, M., and Lee, R. U. (2018). Narrative assemblages for power-balanced coastal and marine governance. Tara Bandu as a tool for community-based fisheries co-management in Timor-Leste. *Marit. Stud.* 17, 55–67. doi: 10.1007/s40152-018-0093-9
- AMSAT International (2011a). *Fish and Animal Protein Consumption and Availability in Timor-Leste. Regional Fisheries Livelihoods Programme for South and Southeast Asia (GCP/RAS/237/SPA) Field Project Document 2011/TIM/02*. Rome: FAO.
- AMSAT International (2011b). *Regional Fisheries Livelihoods Programme Baseline Survey in Timor-Leste. Regional Fisheries Livelihoods Programme for South and Southeast Asia (GCP/RAS/237/SPA) Field Project Document 2011/TIM/1*. Rome: FAO.
- Armitage, D. R., Plummer, R., Berkes, F., Arthur, R. I., Charles, A. T., Davidson-Hunt, I. J., et al. (2009). Adaptive co-management for social-ecological complexity. *Front. Ecol. Environ.* 7, 95–102. doi: 10.1890/070089
- Babo-Soares, D. (2004). Nahe Biti: the philosophy and process of grassroots reconciliation (and justice) in East Timor. *Asia Pac. J. Anthropol.* 5, 15–33. doi: 10.1080/1444221042000201715
- Bailey, C., and Zerner, C. (1992). Community-based fisheries management institutions in Indonesia. *Marit. Anthropol. Stud.* 5, 1–17.
- Barros Duarte, J. (1984). *Timor. Ritos e mitos Atauiros*. Lisboa: Instituto de Cultura e Língua Portuguesa.
- Berkes, F. (2009). Evolution of co-management: role of knowledge generation, bridging organizations and social learning. *J. Environ. Manage.* 90, 1692–1702. doi: 10.1016/j.jenvman.2008.12.001
- Blythe, J., Cohen, P., Eriksson, H., Cinner, J., Boso, D., Schwarz, A.-M., et al. (2017). Strengthening post-hoc analysis of community-based fisheries management through the social-ecological systems framework. *Mar. Policy* 82, 50–58. doi: 10.1016/j.marpol.2017.05.008
- Brackhane, S., Webb, G., Xavier, F. M. E., Gusmao, M., and Pechacek, P. (2018). When conservation becomes dangerous: Human-Crocodile conflict in Timor-Leste. *J. Wildl. Manag.* 82, 1332–1344. doi: 10.1002/jwmg.21497
- Charles, A., Westlund, L., Bartley, D. M., Fletcher, W. J., Garcia, S., Govan, H., et al. (2016). Fishing livelihoods as key to marine protected areas: insights from the World Parks Congress. *Aquat. Conserv. Mar. Freshw. Ecosyst.* 26, 165–184. doi: 10.1002/aqc.2648
- Christie, P. (2004). Marine protected areas as biological successes and social failures in Southeast Asia. *Am. Fish. Soc. Symp.* 42, 155–164. doi: 10.1016/S0002-9610(03)00290-3
- Chuenpagdee, R., and Jentoft, S. (2013). “Assessing Governability – What’s Next,” in *Governability of Fisheries and Aquaculture. MARE Publication Series*, eds M. Bavinck, R. Chuenpagdee, S. Jentoft, and J. Kooiman (Dordrecht: Springer), doi: 10.1007/978-94-007-6107-0
- Cinner, J. E. (2011). Social-ecological traps in reef fisheries. *Glob. Environ. Chang.* 21, 835–839. doi: 10.1016/j.gloenvcha.2011.04.012
- Cinner, J. E., Daw, T. M., and McClanahan, T. (2008). Socioeconomic factors that affect artisanal fishers’ readiness to exit a declining fishery. *Conserv. Biol.* 23, 124–130. doi: 10.1111/j.1523-1739.2008.01041.x
- Clarke, P., and Jupiter, S. D. (2010). Law, custom and community-based natural resource management in Kubulau District (Fiji). *Environ. Conserv.* 37, 98–106. doi: 10.1017/S0376892910000354
- Cohen, P. J., Evans, L. S., and Mills, M. (2012). Social networks supporting governance of coastal ecosystems in Solomon Islands. *Conserv. Lett.* 5, 376–386. doi: 10.1111/j.1755-263X.2012.00255.x
- Cohen, P. J., Song, A. M., and Morrison, T. H. (2017). “Policy Coherence with the Small-Scale Fisheries Guidelines: Analysing Across Scales of Governance in Pacific Small-Scale Fisheries,” in *The Small-Scale Fisheries Guidelines: Global Implementation*, eds S. Jentoft, R. Chuenpagdee, M. J. Barragán-Paladines, and N. Franz (Cham: Springer International Publishing), 57–77. doi: 10.1007/978-3-319-55074-9_4
- Cohen, P. J., and Steenbergen, D. J. (2015). Social dimensions of local fisheries co-management in the Coral Triangle. *Environ. Conserv.* 42, 278–288. doi: 10.1017/S0376892914000423
- Cole, S. M., McDougall, C., Kaminski, A. M., Kefi, A. S., Chilala, A., and Chisule, G. (2018). Postharvest fish losses and unequal gender relations: drivers of the social-ecological trap in the Barotse Floodplain fishery, Zambia. *Ecol. Soc.* 23:art18. doi: 10.5751/ES-09950-230218
- Costa Pereira, C., Pinto, R., Mohan, C., and Atkinson, S. (2013). *Guidelines for Establishing Co-Management of Natural Resources in Timor-Leste*. Jakarta: Conservation International. Available at: <https://ctknetwork.coraltriangleinitiative.org/wp-content/documents/pdf/Guidelines-for-Establishing-Co-Management-of-Natural-Resources-in-Timor-Leste.pdf>
- Cummins, D. (2015). *Local Governance in Timor-Leste: Lessons in Postcolonial State-Building*. Abingdon: Routledge.
- Cummins, D., and Leach, M. (2012). Democracy old and new: the interaction of modern and traditional authority in east timorese local government. *Asian Polit. Policy* 4, 89–104. doi: 10.1111/j.1943-0787.2011.01321.x
- da Cruz, C. J. (2016). “Improving food security through agricultural development in Timor-Leste: experiences under 13 years of democratic government,” in *Food Security in Timor-Leste Through Crop Production: Proceedings of TimorAg2016, an International Conference held in Dili, Timor-Leste*, ed. H. Nesbitt (Canberra, ACT: ACIAR).
- Davis, A., and Ruddle, K. (2012). Massaging the misery: recent approaches to fisheries governance and the betrayal of small-scale fisheries. *Hum. Organ.* 71, 244–254. doi: 10.17730/humo.71.3.205788362x751128

- Dirhamsyah. (2013). The community-based and co-management concept for coral reef management in the Raja Ampat Islands. *Aust. J. Marit. Ocean Aff.* 5, 65–73. doi: 10.1080/18366503.2013.10815734
- Edivane, K., de Carvalho, N., Penny, S., Fernandes, A., de Cunha, C. B., Amaral, K., et al. (2009). *Conservation Value, Issues and Planning in the Nino Konis Santana Marine Park, Timor Leste – Final Report*, ed. GOTL (Dili: Ministry of Agriculture and Fisheries).
- Evans, L., Cherrett, N., and Pems, D. (2011). Assessing the impact of fisheries co-management interventions in developing countries: a meta-analysis. *J. Environ. Manage.* 92, 1938–1949. doi: 10.1016/j.jenvman.2011.03.010
- FAO (2018). *The State of World Fisheries and Aquaculture 2018 - Meeting the Sustainable Development Goals*. Rome: FAO.
- Féjő, R. G. (2015). Timor-Leste: the adventurous tribulations of local governance after independence. *J. Curr. Southeast Asian Aff.* 34, 85–114. doi: 10.1177/186810341503400104
- Foale, S. J., and Manele, B. (2004). Social and political barriers to the use of marine protected areas for conservation and fishery management in Melanesia. *Asia Pac. Viewp.* 45, 373–386. doi: 10.1111/j.1467-8373.2004.00247.x
- Folke, C., Hahn, T., Olsson, P., and Norberg, J. (2005). Adaptive governance of social-ecological systems. *Annu. Rev. Environ. Resour.* 30, 441–473. doi: 10.1146/annurev.energy.30.050504.144511
- GOTL (2011). *Timor-Leste Strategic Development Plan 2011-2030*. Dili: Timor-Leste Government.
- GOTL (2015). *National Census*. Available at: <http://www.statistics.gov.tl/category/publications/census-publications/2015-census-publications/volume-3-social-and-economic-characteristics/2-main-economic-activity/> (accessed February 24, 2019).
- Govan, H. (2009). *Status and Potential of Locally-Managed Marine Areas in the Pacific Island Region: Meeting Nature Conservation and Sustainable Livelihood Targets Through Wide-spread Implementation of LMMAs*. Germany: University Library of Munich.
- Govan, H. (2013). *Review of Guadalcanal and Central Islands Provincial Governments Capacity for Implementation of the NPOA: Strengthening the Role of Provincial-Level Governments in Community Based Resource Management Part 1: Review*. Report for SIG and PSLP under the Coral Triangle Initiative. Available at: <http://bit.ly/161Excp>
- Govan, H., Schwarz, A., and Boso, D. (2011). *Towards Integrated Island Management: Lessons from Lau, Malaita, for the Implementation of a National Approach to Resource Management in Solomon Islands*. Work. Pap. Available at: <http://ideas.repec.org/b/wfi/wfbook/39500.html> (accessed April 30, 2019).
- Graham, N. A. J., and McClanahan, T. R. (2013). The last call for marine wilderness? *BioScience* 63, 397–402. doi: 10.1525/bio.2013.63.5.13
- Grebner, K., von Prasai, N., Yin, S., Yohannes, Y., Towey, O., Sonntag, A., et al. (2015). *2015 Global Hunger Index: Armed Conflict and the Challenge of Hunger*. Washington, DC: International Food Policy Research Institute.
- Gurney, G. G., Cinner, J., Ban, N. C., Pressey, R. L., Pollnac, R., Campbell, S. J., et al. (2014). Poverty and protected areas: an evaluation of a marine integrated conservation and development project in Indonesia. *Glob. Environ. Change* 26, 98–107. doi: 10.1016/j.gloenvcha.2014.04.003
- Gutiérrez, N. L., Hilborn, R., and Defeo, O. (2011). Leadership, social capital and incentives promote successful fisheries. *Nature* 470, 386–389. doi: 10.1038/nature09689
- Halpern, B. S., Lester, S. E., and McLeod, K. L. (2010). Placing marine protected areas onto the ecosystem-based management seascape. *Proc. Natl. Acad. Sci. U.S.A.* 107, 18312–18317. doi: 10.1073/pnas.0908503107
- Hamilton, R. J., Hughes, A., Brown, C. J., Leve, T., and Kama, W. (2019). Community-based management fails to halt declines of bumphead parrotfish and humphead wrasse in Roviana Lagoon, Solomon Islands. *Coral Reefs* 38, 455–465. doi: 10.1007/s00338-019-01801-z
- Hicks, D. (2004). *Tetum Ghosts and Kin: Fertility and Gender in East Timor*. Long Grove, IL: Waveland Press.
- Jentoft, S. (2014). Walking the talk: implementing the international voluntary guidelines for securing sustainable small-scale fisheries. *Marit. Stud.* 13:16. doi: 10.1186/s40152-014-0016-3
- JICA (2015). *Operation Manual for Establishment of the CB-NRM Mechanism at the Village Level*. Chiyoda: JICA.
- Johannes, R. E. (1981). *Words of the Lagoon: Fishing and Marine Lore in the Palau District of Micronesia*. Berkeley, CL: University of California Press.
- Jupiter, S. D., Cohen, P. J., Weeks, R., Tawake, A., and Govan, H. (2014). Locally-managed marine areas: multiple objectives and diverse strategies. *Pac. Conserv. Biol.* 20, 165–179. doi: 10.1071/PC140165
- Khan, M. A., Alam, M. F., and Islam, K. J. (2012). The impact of co-management on household income and expenditure: an empirical analysis of common property fishery resource management in Bangladesh. *Ocean Coast. Manag.* 65, 67–78. doi: 10.1016/j.ocecoaman.2012.04.014
- Klein, C. J., Jupiter, S. D., Watts, M., and Possingham, H. P. (2014). Evaluating the influence of candidate terrestrial protected areas on coral reef condition in Fiji. *Mar. Policy* 44, 360–365. doi: 10.1016/j.marpol.2013.10.001
- Léopold, M., Beckensteiner, J., Kaltavara, J., Raubani, J., and Caillon, S. (2013). Community-based management of near-shore fisheries in Vanuatu: what works? *Mar. Policy* 42, 167–176. doi: 10.1016/j.marpol.2013.02.013
- López-Angarita, J., Hunnam, K. J., Pereira, M., Mills, D. J., Pant, J., Teoh, S. J., et al. (2019). *Fisheries and Aquaculture of Timor-Leste in 2019: Current Knowledge and Opportunities*. Penang: WorldFish.
- MacNeil, M. A., Graham, N. A. J., Cinner, J. E., Wilson, S. K., Williams, I. D., Maina, J., et al. (2015). Recovery potential of the world's coral reef fishes. *Nature* 520, 341–344.
- MAFF (2005). *Fish for Sustainability. Our Strategic Plan for Fisheries (2006-2011)*. Dili: Ministry of Agriculture and Fisheries.
- Magalhães, A. L. d. (1918). A ilha de Ataúro. Notícia sobre a ilha e seus habitantes. *Bull. Soc. Geogr. Lisboa XXXVIa*, 53–70.
- Mallao, R. J., Pomeroy, R. S., and Turingan, R. G. (2009). Performance of community-based coastal resource management (CBCRM) programs in the Philippines: a meta-analysis. *Mar. Policy* 33, 818–825. doi: 10.1016/j.marpol.2009.03.003
- McCoy, K., Andrew, G., Lino, K., Schumacher, B., Sudnovsky, M., and Ayotte, P. (2015). *Coral Reef Fish Biomass and Benthic Cover Along the North Coast of Timor-Leste Based on Underwater Visual Surveys in June 2013*. Honolulu, HI: Pacific Islands Fisheries Science Center.
- McWilliam, A. (2003). Timorese seascapes: perspectives on customary marine tenures in East Timor. *Asia Pac. J. Anthropol.* 3, 6–32. doi: 10.1080/14442210210001706266
- McWilliam, A., Palmer, L., and Shepherd, C. (2014). Lulic encounters and cultural frictions in East Timor: past and present. *Aust. J. Anthropol.* 25, 304–320. doi: 10.1111/taja.12101
- Mills, D., Abernethy, K., King, J., Hoddy, E., Jiau, T. S., Larocca, P., et al. (2013). *Developing Timor-Leste's Coastal Economy: Assessing Potential Climate Change Impacts and Adaptation Options*. Penang: WorldFish.
- Mills, D. J., and Tilley, A. (2017). *Exploring Opportunities to Improve Coastal livelihoods and Resource Management in Timor-Leste's Coastal Communities. Final Report*. Canberra, ACT: ACIAR.
- Mills, D. J., Tilley, A., Pereira, M., Hellebrandt, D., and Fernandes, A. (2017). Livelihood diversity and dynamism in Timor-Leste: insights for coastal resource governance and livelihood development. *Mar. Policy* 82, 206–215. doi: 10.1016/j.marpol.2017.04.021
- Mills, D. J., Westlund, L., Graaf, G. de, Kura, Y., Willman, R., and Kelleher, K. (2011). “Under-reported and undervalued: small-scale fisheries in the developing world,” in *Small-Scale Fisheries Management: Frameworks and Approaches for the Developing World*, eds R. S. Pomeroy and N. L. Andrew (Wallingford: CABI), 1–15.
- Miyazawa, N. (2013). “Customary law and community-based natural resource management in post-conflict Timor-Leste,” in *Land and Post-Conflict Peacebuilding*, eds J. Unruh and R. Williams (London: Earthscan).
- Murphree, M. W. (2009). The strategic pillars of communal natural resource management: benefit, empowerment and conservation. *Biodivers. Conserv.* 18, 2551–2562. doi: 10.1007/s10531-009-9644-0
- NDA (2012). *Timor-Leste National Aquaculture Development Strategy (2012–2030)*. Dili: National Directorate of Fisheries and Aquaculture (NDA).
- NDA (2016). *The National Fisheries Statistics System of Timor-Leste*. Rome: FAO.
- Needham, S., Alonso-Población, E., Wilson, C., Rodrigues, P., Pereira, M., and Griffiths, D. (2013). *Community-based Data Gathering and co-management of Marine Resources in Timor-Leste*. Bangkok: Regional Fisheries Livelihoods Programme for South and Southeast Asia.
- Nuon, V., and Gallardo, W. (2011). Perceptions of the local community on the outcome of community fishery management in Krala Peah village, Cambodia.

- Int. J. Sustain. Dev. World Ecol.* 18, 453–460. doi: 10.1080/13504509.2011.584199
- O'Garra, T. (2009). Bequest values for marine resources: how important for indigenous communities in less-developed economies? *Environ. Resour. Econ.* 44:179. doi: 10.1007/s10640-009-9279-3
- Ostrom, E. (1990). *Governing the Commons: The Evolution of Institutions for Collective Action*. Cambridge: Cambridge University Press.
- Park, S. E., Abernethy, K., Attwood, S. J., Beare, D., Cohen, P., Govan, H., et al. (2012). *Responding to Climate Change Using an Adaptation Pathways and Decision-Making Approach*. Penang: WorldFish.
- Pomeroy, R., Parks, J., Reaugh-Flower, K., Guidote, M., Govan, H., and Atkinson, S. (2015). Status and priority capacity needs for local compliance and community-supported enforcement of marine resource rules and regulations in the coral triangle region. *Coast. Manag.* 43, 301–328. doi: 10.1080/08920753.2015.1030330
- Pomeroy, R. S., and Berkes, F. (1997). Two to tango: the role of government in fisheries co-management. *Mar. Policy* 21, 465–480. doi: 10.1016/S0308-597X(97)00017-1
- Rohe, J. R., Aswani, S., Schlüter, A., and Ferse, S. C. A. (2017). Multiple drivers of local (Non-) compliance in community-based marine resource management: case studies from the South Pacific. *Front. Mar. Sci.* 4:172. doi: 10.3389/fmars.2017.00172
- Rohe, J. R., Govan, H., Schlüter, A., and Ferse, S. C. (2019). A legal pluralism perspective on coastal fisheries governance in two Pacific Island countries. *Mar. Policy* 100, 90–97. doi: 10.1016/j.marpol.2018.11.020
- Sandlund, O. T., Bryceson, I., Demetrio de Carvalho, N. R., and Joana da Silva, M. I. S. (2001). *Assessing Environmental Needs and Priorities in East Timor: Issues and Priorities*. Dili: UNDP.
- Sanyu Consulting (2003). *Study for the Integrated Agricultural Development, Democratic Republic of Timor-Leste (2001–2003)*. Quezon City: Sanyu Consultants Inc.
- Sen, S., and Nielsen, J. R. (1996). Co-Management: a comparative analysis. *Mar. Policy* 20, 405–418. doi: 10.1016/0308-597X(96)00028-0
- Shepherd, C. J. (2004). Fractures of cultures: towards an anthropology of development on east timor. *Stud. Lang. Cult. East Timor* 6, 100–118.
- Shepherd, C. J. (2009). Participation, authority, and distributive equity in East Timorese development. *East Asian Sci. Technol. Soc.* 3, 315–342. doi: 10.1007/s12280-009-9098-1
- Shepherd, C. J. (2013). *Development and Environmental Politics Unmasked: Authority, Participation and Equity in East Timor*. London: Routledge.
- Sonmes, S. F. (1998). Tourism, terrorism and political instability. *Ann. Tour. Res.* 25, 416–456. doi: 10.1016/S0160-7383(97)00093-5
- Stockwell, A. (2001). *Introduction to Co-Management or Community-Based Management of Coastal Resources*. Dili: Second Agricultural Rehabilitation Programme, World Bank.
- Stockwell, A. (2002). *Coastal Habitat Assessment and Monitoring Procedures*. Dili: Second Agricultural Rehabilitation Project, World Bank, Department of Fisheries and the Marine Environment.
- UNWTO (2017). *UNWTO Tourism Highlights, 2017 Edn*. Madrid: UNWTO. doi: 10.18111/9789284419029
- Wamukota, A. W., Cinner, J. E., and McClanahan, T. R. (2012). Co-management of coral reef fisheries: a critical evaluation of the literature. *Mar. Policy* 36, 481–488. doi: 10.1016/j.marpol.2011.09.001
- Weeks, R., Aliño, P. M., Atkinson, S., Beldia, P. II, Binson, A., Campos, W. L., et al. (2014). Developing Marine Protected Area networks in the Coral Triangle: good practices for expanding the Coral Triangle Marine Protected Area System. *Coast. Manage.* 42, 183–205. doi: 10.1080/08920753.2014.877768
- West, P., Igoe, J., and Brockington, D. (2006). Parks and peoples: the social impact of protected areas. *Annu. Rev. Anthropol.* 35, 251–277. doi: 10.1146/annurev.anthro.35.081705.123308
- World Bank (2012). *Hidden Harvest: The Global Contribution of Capture Fisheries*. Washington, DC: World Bank.
- World Bank (2018). *Timor-Leste Economic Report, March 2018*. Dili, Timor-Leste. Washington, DC: World Bank.
- Young, O. R., Webster, D. G., Cox, M. E., Raakjær, J., Blaxekjær, L. Ø., Einarsson, N., et al. (2018). Moving beyond panaceas in fisheries governance. *Proc. Natl. Acad. Sci. U.S.A.* 115, 9065–9073. doi: 10.1073/PNAS.1716545115

Conflict of Interest Statement: The authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

Copyright © 2019 Tilley, Hunnam, Mills, Steenbergen, Govan, Alonso-Poblacion, Roscher, Pereira, Rodrigues, Amador, Duarte, Gomes and Cohen. This is an open-access article distributed under the terms of the Creative Commons Attribution License (CC BY). The use, distribution or reproduction in other forums is permitted, provided the original author(s) and the copyright owner(s) are credited and that the original publication in this journal is cited, in accordance with accepted academic practice. No use, distribution or reproduction is permitted which does not comply with these terms.