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Coral Reef Management and *Tara Bandu* on Ataúro Island: an ecologist's perspective

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Abstract

Coral reefs are among the most diverse and threatened ecosystems globally. Timor-Leste lies within the Coral Triangle, the epicenter of marine biodiversity. Coastal marine resources in the Coral Triangle, including coral reefs, provide significant economic and social benefits to the 360 million residents. As a coral ecologist working in Timor-Leste, it became apparent very quickly that the socio-economic and cultural aspects of Timorese society also affect the coral reefs. *Tara bandu* as a means of marine conservation is a relatively recent practice in Timor-Leste with the first *tara bandu* Locally Managed Marine Area (LMMA) implemented in Adara on the west coast of Ataúro Island in 2015. The community in Usubemassau, Beloi *suco* on the east coast followed suit establishing an LMMA on *Haruina* in July 2017. Here, *tara bandu* as a means of marine conservation on Ataúro Island was further investigated in 2019 to attempt to learn more about this movement in addition to identifying what these LMMAs were protecting ecologically. The two main aims of these LMMAs were 1) to preserve fisheries and 2) income generation from the 'reef tax' fees received from tourists. The expansion of *tara bandu* LMMAs to the remaining island communities happened quickly over the next few years. However, the successes of the initial LMMAs were not necessarily transferrable to other communities. Challenges identified in achieving these goals ranged from geography to coordination with SCBUA dive operators. These issues plus potential impacts on the reef are further discussed.

Keywords: coral reefs, Timor-Leste, Coral Triangle, *tara bandu*, customary law, marine conservation, tourism, socio-ecological systems, sustainability

Coral Reefs in Timor-Leste: current state and importance

Timor-Leste's coral reefs harbor a high degree of biodiversity as one of six member-states (Timor-Leste, Indonesia, Malaysia, Papua New Guinea, the Philippines, and the Solomon Islands) in the Coral Triangle, the global epicenter of marine biodiversity (Erdmann & Mohan, 2013; Veron et al., 2009). The 360 million residents of the Coral Triangle rely on these significant coastal marine ecosystems, including coral reefs, for economic and social benefits such as food, income, recreation, and culture (ADB, 2014). Ataúro Island is a small (140 km²) volcanically derived island 30 km north of the capital of Dili, Timor-Leste (Figure 1). The island has recently become a hub of tourism. The coral reef fish biodiversity on Ataúro Island was documented through a Rapid Assessment Program in 2016 on par with Bird's Head peninsula in Raja Ampat, West Papua, Indonesia the site of highest recorded marine biodiversity (Erdmann, 2016).



Figure 1: Ataúro Island is approximately 30 km north of Dili, the capital of Timor-Leste. Three communities (Adara, Beloi, and Vila) were investigated for tara bandu practices in marine conservation on Ataúro Island in 2019. Sites of previous coral surveys in 2015 and 2017 are also shown.

The country has had a reputation of having 'pristine reefs' (Esters & Erdmann, 2012) however, recent analyses have indicated that a history of deforestation and subsistence-based livelihoods such as fishing and gleaning have impacted coral reefs (Erdmann, 2016; Kim et al., 2020; Sandlund et al., 2001). Gleaning is an important part of subsistence livelihoods and makes up a significant portion of fishers globally (Burgos, in review; Grantham et al., 2021; Teh et al., 2013; Tilley et al., 2020). Impacts of regular gleaning have been posited from remotely sensed changes in reef composition

(Andréfouët et al., 2013), but this area of research is understudied. While conducting previous fieldwork at four sites on Ataúro Island and the Dili area in 2015 and 2017, gleaning and fishing were observed to be much higher at Dili Rock versus other sites (Beloi, Cristorei, Be'hau; **Figure 1**). Dili Rock also had the lowest coral cover (< 5%) at 5 m depth which indicated that human population pressures facilitated by ease of access to marine resources resulted more impacts to shallow coral reefs through increased fishing and gleaning (Kim et al., 2020).

Across Timor-Leste, average coral cover (i.e., percentage of the benthos covered by live coral) was found to be low (15.0%) analyzing over 20,000 photoquadrats taken from kilometer-scale transects captured in 2014 (Kim, 2021). This estimate places coral cover in Timor-Leste lower than Indo-Pacific averages ranging from 22–24% from metanalyses although there was very little data from Timor-Leste in these regional analyses (Bruno & Selig, 2007; Graham & Nash, 2013). Percent coral cover, however, was also highly variable ranging from 0.0–64.18% at the subtransect level with a maximum length of 100 m (Kim, 2021). This heterogeneity was also found through additional small-scale surveys at four sites (Beloi, Cristorei, Dili Rock, and Be'hau) across two surveys in November 2015 and July 2017 (Figure 1; Kim et al., 2020).

Although Timor-Leste is not immune to the localized impacts that affect coral reefs, the marine environments along the north coast are a potential climate refugium in terms of ocean warming (Kim et al., 2020). This corroborates the country's inclusion as one of 50 global reef regions that are comparatively less vulnerable to the impacts of climate change from a global analysis. Thus, these 50 regions would have a high return on conservation investment (Beyer et al., 2018). As such, immediate conservation efforts in Timor-Leste should focus on mitigating local stressors to coral reefs such as sedimentation from land and overfishing. Further understanding of the local social-ecological systems involved in marine conservation practices is essential to successful outcomes.

Research context and study objectives

Tara bandu ('to hang a prohibition') customary ritual regulation of resources is a traditional means of land and resource tenure through the ritualized inscription of rules, prohibitions, and punishments for transgressions over an area (De Carvalho & Correia, 2011; Palmer, 2016; Yoder, 2007). Traditional practices such as *tara bandu* during the Indonesian occupation were largely repressed, but since independence, it has experienced a resurgence (McWilliam, 2003; Yoder, 2005). The process is very localized and the support and use of *tara bandu* by state, international development organizations, and non-governmental organizations (NGOs) for resource management and development interests have demonstrated both positive negative effects (Mills & Tilley, 2017; Palmer & McWilliam, 2019; Shepard, 2013; Silva, 2017; Tilley et al., 2019). However, the use of these customary practices concerning coastal marine environments is less well understood (McWilliam, 2002; Población et al., 2016) with the first marine *tara bandu* designated in Beacou in 2012 (Mills & Tilley, 2017; Población et al., 2016).

Implementation of *tara bandu* post-independence has been identified as mechanism to promote environmental conservation and management (De Carvalho & Correia, 2011; Yoder, 2007). *Tara bandu* has since been diversified as a tool to address problems in other spheres such as social (i.e., pacification of youth gangs) and economic development (see Palmer, 2016; Silva, 2017).

On Ataúro Island, the focus of *tara bandu* appears to be on environmental conservation and economic gains. For the first marine *tara bandu* on the island in Adara, the management measures were developed over a period of 12 months with rules pertaining to general fishing practices and to the closure of the marine area adjacent to the tourism venture banning extractive activities such as fishing and gleaning (i.e., no-take). The community exploited its growing reputation as an off-the-beaten track tourism destination and established a \$1.50 USD “reef tax” for snorkelers and SCUBA divers entering the no-take locally managed marine area (LMMA; Mills & Tilley, 2017). An elected committee of three community members were responsible for the safekeeping of the raised fund until the community decides to publicly open the cash box and vote on communal projects to utilize the funds (Tilley et al., 2019). A set of incremental penalties were also established for rule breaking and the rules were formally recognized in a written document which was approved by the Pastor and local government departments. As a Protestant community, a ribbon cutting ceremony and prayer was conducted in lieu of the traditional hanging ceremony for the formal *tara bandu* declaration supported by WorldFish. Over 200 people from Adara, neighboring communities, church authorities, government authorities, international organizations, and NGOs attended on May 13th, 2016 (Mills & Tilley, 2017; Tilley et al., 2019).

Furthermore, a few weeks prior to the second coral reef survey in July 2017, the Beloi community had just implemented the Locally Managed Marine Area (LMMA) through *tara bandu* (Kim et al., 2020). A small fee was paid by the researchers to the community through the SCUBA dive operators to resurvey *Haruina* which was within the bounds of the LMMA. The goals of the LMMAs were perceived by the researcher to be as follows: 1) sustainable management of fisheries and 2) income generation from reef tax fees from tourists and tourism operators (i.e., SCUBA diving businesses). The focus of this paper is to further investigate the use of *tara bandu* customary law as a means of marine conservation on Ataúro Island. The financial goal is largely dependent on the LMMA raising enough funds through tourism to offset any loss of access to the protected marine resource. Although this can be achieved as demonstrated in Adara, reliance on tourism can be risky and building resilience into social-ecological systems to compensate for disruptions such as slow tourism years and COVID-19 travel restrictions is imperative (King et al., 2021).

The aims of the work presented here were two-fold. First, to investigate *tara bandu* as a means of marine conservation on Ataúro Island and explore its connections to the development of tourism on the island. For ecological purposes, marine protected areas are implemented to conserve marine habitats and resources. As the *tara bandu* LMMAs

appear to encompass both environmental and economic goals, the second aim was to characterize the marine habitats found within and adjacent to these LMMA zones to determine the condition of the habitats the LMMAs were protecting.

Study Site

The presented study was undertaken during fieldwork from mid-July through mid-October of 2019. Three communities were targeted to learn more about *tara bandu* on Ataúro Island: Adara, Beloi, and Vila (Figure 1). Interviews were conducted with key community members to gain insights into the implementation of *tara bandu* and potential effects. Visual surveys of the LMMAs and adjacent habitats were observed in each community. Views from observations and interactions with SCUBA dive operators that frequent the island were also solicited.

Implementation of *Tara Bandu*

Adara, on the west side of the island, was the flagship community in implementing a no-take LMMA through *tara bandu* on Ataúro on May 13th, 2016 following 12 months of community consultation (Mills & Tilley, 2017; Tilley et al., 2019). Subsequently, Beloi and Vila established similar MPAs through *tara bandu* in 2017 and 2018, respectively. By the end of 2019, almost all communities (12 total) on Ataúro had implemented *tara bandu* LMMAs supported by Conservation International Timor-Leste. The exponential increase in the creation of these LMMAs does not bode well for the proper consultation concerning the unique geographic settings of each community. The quick implementation after the first few LMMAs was likely spurred by the initial success of the original MPAs. After nine months of establishing a 1.50 USD reef tax for snorkeling and diving within Adara's LMMA, the community-generated 1,500 USD for the community fund (Mills & Tilley, 2017). This fund was a significant economic benefit for the community funding a kindergarten and development of the piped water infrastructure (Tilley et al., 2019).

Several non-governmental organizations (NGOs) have also been involved in this process of LMMA designation. The Adara community has had a working relationship with WorldFish prior to 2012 (Mills & Tilley, 2017). A key community member, "Super" Mario Gomes, was essential as a community liaison as a part-time employee of WorldFish. He also worked at the main guesthouse Barry's Place in Beloi and instigated the development of the successful guesthouse in Adara (M. Gomes personal communication, August 28th, 2019). Adara also had a steady stream of SCUBA diving tourists as the west coast was frequented by Compass Boating & Diving (henceforth Compass) who maintained accommodation in Adara until 2019. However, there are plans to re-open the Adara accommodations in late 2021 (S. Haron, personal communication, March 2nd, 2021). The implementation of the Adara LMMA through *tara bandu* was largely a community-driven process (Mills & Tilley, 2017). The community of Vila is home to the NGO, Roman Luan, established by a local Avelino Fernandes. Roman Luan is partnered with the Coral Triangle Center and this partnership of NGOs has proposed a management plan for the Ataúro Island LMMAs (CTC Admin, 2019). Conservation International has

also been active in marine conservation on the island since 2015 and indicates on their website as contributing to the setup of a system of LMMAs (Price, 2019). Clearly, there are competing interests between these NGOs in declaring the establishment of LMMA networks.

Characterization of marine habitats

Like the previous sites which were the focus of coral surveys, the marine habitats adjacent to these villages (Adara, Beloi, Vila) were unique in composition. The two sides of the island experience seasonally variable wind and wave patterns. The west side of the island is characterized by gently sloping intertidal and reef flat zones which drop to near-vertical walls to great depths approximately 150 m offshore. The reef flat in front of Adara (inside the no-fishing LMMA) was shockingly bare akin to pavement (Figure 2). Moving north and south outside of the LMMAs there was an increased cover of corals and soft corals. Although this was initially counter-intuitive, the environments closest to the community were likely most heavily used for fishing and gleaning before the establishment of the no-take LMMA. Additionally, this area was likely heavily impacted by the daily dragging in of fishing boats and associated trampling. Since the implementation of the LMMA, boat traffic has been redirected to the north of the LMMA.



Figure 2 Reef flat edge in Adara characterized by bare consolidated pavement rock with sparse coverage of small corals.

In Vila, there were extensive seagrass beds for 100–150 m perpendicular to shore which transitions to shallow coral reefs sloping into deeper waters about 250 m offshore. The shallow reefs are dominated by massive corals such as *Porites* spp. (Figure 3). There is a well-known guesthouse and restaurant in the community, but the marine tourism activities are largely focused in Beloi.



Figure 3 Reef flat offshore of Vila characterized by massive corals and soft corals.

Beloi is the hub of the island with the ferry from Dili arriving twice a week on Thursdays and Saturdays. *Haruina*, the reef directly in front of the community, is a barrier reef detached from shore by the channel serving as a conduit for boat traffic which differentiates it from most other reefs on Ataúro and in-country. The areas directly in front of the beach are barren and rubbly which is likely a consequence of swimming and boat traffic. Only ~350 m from shore, *Haruina* is likely one of the most pristine sites in the country in terms of the coral community. The reef has high coral cover (~ 50%) dominated by tabulate Acroporids which was not found at the other three sites from the previous coral surveys (Kim et al., 2020) or in Adara and Vila (Figure 4).



Figure 4 High coral cover reef flat of Haruina offshore of Beloi dominated by tabulate Acroporids. Photo: F. Ryan 2017.

Challenges of implementing *tara bandu* MPAs

There are several SCUBA dive operators based in or that frequent Beloi on the east coast (Dive Timor Lorosa'e, Ataúro Dive Resort, Beloi Beach Hotel, Blue Ventures, Compass) and one operator who frequents Adara on the west side of the island (Compass). Conservation International has been leading discussions with the dive operators in the creation of a payment system for bringing tourists to the LMMA zones. Sitting in on one of these discussions, the general attitude of the diver operators toward the user-fee model was overall acceptance and compliance although frustrations in dealing with additional fees on already tight operating costs were observed.

The new LMMA zones also caused a degree of conflict between dive operators and communities. Namely, communities that previously did not receive dive tourists suddenly had a vested interest in having visitors with the implementation of user-pays LMMAs. These communities inquired to dive operators as to why they were not utilizing the community LMMAs and thus bringing in tourism dollars when the dive operators generally did not visit these sites previously. There were also questions from the operators as to who counted in needing to pay the reef tax. For example, were foreign dive staff and

Timorese staff required to pay for every usage in the LMMA? Inclusion of staff would result in greater expenses for the businesses. In general, all community members seemed to be subject to the 'reef tax' for usage of the *tara bandu* LMMAs (Burgos, in review). The relationship between the SCUBA operators and communities was observed to be good overall. However, occasional conflicts have occurred between parties such as accusations of dive operators cutting *burbur* fish trap lines (R. Grantham, personal communication, September 23rd, 2019).

Compass is the main business that reliably brings divers to Ataúro from Dili on day trips and has accommodation in Beloi and formerly in Adara. The northern and southernmost parts of the island can have dangerous diving conditions during parts of the year which dissuades dive tourism; additionally, traveling from Dili to the northern end of the island where there are now LMMAs also represents increased time and fuel costs for the business. As such, not all communities are geographically situated to bring in tourism dollars through a user-pays model. Details such as the billing (annual, quarterly, etc.), accounting (fees applying for tourists only or also staff), and disbursement (communities receive a cut proportional to the number of visitors, equal portions, etc.) of LMMA fees were being discussed in meetings with dive operators toward the end of 2019. A blog post dated October 22nd, 2019 on the Conservation International website indicates that an annual fee between the Ataúro LMMA network and the dive operators has been negotiated (Price, 2019). Positive interactions between dive operators and communities were also observed during fieldwork such as the translation of diver feedback surveys for dissemination to the communities. SCUBA dive operators are important players in building the capacity of Timorese in the marine tourism industry and often employ Timorese boating and diving staff. Operators also invest in SCUBA diving training of Timorese staff where typical dive certifications often cost more than 500 USD with multiple levels of training. The ongoing communication and cooperation between the LMMA network on Ataúro Island and tourism businesses are essential.

Sustainable marine tourism has been extensively promoted as a priority for economic development in the country by the State, international organizations such as the US Agency for International Development's Tourism For All Project, and NGOs with a special focus on Ataúro Island. This commitment was demonstrated by the launch of the Marine Tourism Association in August of 2019. Outside of utilizing SCUBA dive and tour businesses, clear communication of the Ataúro Island LMMA network and payment processes is essential. From personal experience, the process of how much, who, and where to pay for recreating in LMMA zones as a tourist was not transparent. Easy processes of fee payment (payment boxes, through accommodation, etc.) are essential for tourists recreating in LMMA zones independently (not through SCUBA operators) and clear communication of these processes upon arrival, online, etc. is warranted.

The future of *Tara Bandu* MPAs, marine conservation, and tourism

At a country-scale, tourism was already substantially affected in 2019 due to the elimination of one of three international flights into the country (Rose, 2019). The resulting

increase in flight prices resulted in a drop in tourism across all sectors which was felt by diver operators, accommodations, homestays, and the wider community throughout 2019. This was, of course, before the advent of COVID-19 which effectively shut down travel globally. The full extent to which the shutting of national borders and diminished tourism will have in Timor-Leste and marine tourism is yet to be known. Further research on the efficacy of *tara bandu* as a means of marine conservation is warranted especially with the unprecedented impacts of COVID-19. Already, only a year later it has been reported that the community of Vila has decided to discontinue the LMMA (S. Haron, personal communication, March 3rd, 2021). Although the cause is unknown at this time, it is hypothesized that the funds from the LMMA reef tax was not enough to warrant the loss of fishing from the same area. The slow tourism year of 2019 plus ongoing COVID-19 travel bans in 2020 likely contributed. Reports from other regions indicate that fisheries management and marine conservation measures funded through tourism are at risk with decreased tourism and there are greater fishing pressures as local communities turn back to traditional fishing for sustenance (Greenfield & Muiruri, 2020; MPA News, 2021; Vyawahare, 2020). The impacts of these LMMAs such as the equitable distribution of raised funds despite unequal opportunities for tourism warrant further investigation.

As an ecologist, the LMMA network on Ataúro Island provides an opportunity to observe whether eliminating fishing and gleaning pressures contribute to the recovery of coastal marine habitats through comparing inside and outside of no-take LMMAs. The three LMMAs investigated protect three different coastal habitat types. However, the ecological benefits will only manifest if these LMMAs persist on the order of decades. Other management options such as fishing limits or seasonal closures should also be explored to continue community access to marine resources with protection measures.

Tara bandu as a means of marine conservation in Timor-Leste is a prime example of a novel and necessary approach to the future management of coral reefs involving communities in the designation, governance, and financial gain of natural resource protection; however, care must be taken into customizing the model given the unique environmental and social dynamics of any community. Building the capacity of locals to lead these economic and ecological decisions should also be a priority. Finally, as demonstrated by the COVID-19 disruptions and increasingly uncertain environmental future, building resilience in both ecological and social systems is imperative (Williams et al., 2019). The development of interdisciplinary approaches assessing both social and ecological impacts and outcomes is needed in Timor-Leste and globally.

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