

Developing Rights-Based Fisheries to end Manta Hunting in Lamakera, Indonesia

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Abstract

Lamakera, a small fishing community located in East Flores, Indonesia, is one of the most prolific manta ray hunting communities in the world. The international trade in manta ray body parts is worth around USD 10 million annually, and Indonesia is one of the largest global manta fisheries. Lamakerans have been fishing manta rays since ancestry. Until around the late 1990s, the community hunted mantas on an artisanal and subsistence scale, however, as commercial markets developed, the fishery expanded into a commercially driven fishery with a significant increase in fishing effort. Comparison of catches across a 12-year period (2002 to 2014) revealed a 75 percent decline in manta ray and mobula catch despite an increased fishing effort. In January 2014, following the international recognition of both species the of manta ray (*Manta birostris* and *Manta alfredi*) as vulnerable species, Indonesia introduced legislation that banned all manta ray hunting in national waters. The new regulation empowered a coalition of manta conservationists and NGOs, including Misool Foundation, Reef Check Indonesia and Manta Trust to address Lamakera's unsustainable (and now illegal) hunting of manta rays. This coalition aimed to reduce the hunting, safeguard food security for the coastal communities within East Flores, and drive change in marine protection policy in the area. Lamakera community members were invited to join this coalition and, since establishing these partnerships, community associations have been built for those people who made an official pledge to stop hunting manta rays. NGO and governmental support have been provided so that community members can become independent and take ownership of their livelihoods. The initial efforts to transition Lamakera away from illegal manta hunting have included community-based conservation initiatives and law enforcement by the Wildlife Conservation's Society (WCS) WCU (Wildlife Crime Unit) and East Flores law enforcers to stop the remaining hunting activities.

1. INTRODUCTION

In 2013, member countries of the Convention on International Trade in Endangered Species (CITES) voted to include both species of manta ray (*Manta alfredi* and *Manta birostris*) under Appendix 2, thus regulating the trade in these animals' body parts. In January 2014, Indonesia went a giant step further by banning all hunting of manta rays in national waters. The regulation, issued by the Marine and Fisheries Ministry Regulation (Kepmen KP No. 4 2014), banned the hunting, selling and distribution of both species of the manta ray. Violation of this regulation can incur a punishment of a maximum prison sentence of 6 years and a fine of approximately USD 100 000.

Lamakera, a small fishing community located in East Flores, Indonesia, was one of the most prolific manta ray hunting communities in the world. The new regulation empowered a coalition of manta conservationists and NGOs, including Misool Foundation, Reef Check Indonesia and Manta Trust to address Lamakera's unsustainable (and now illegal) hunting of manta rays. This coalition aimed to reduce the hunting, safeguard food security for the coastal communities within East Flores, and drive change in marine protection policy in the area. Additionally, this work intended to support the United Nation's Sustainable Development Goal 14: *Conserve and sustainably use the oceans, seas and marine resources for sustainable development*.

This case study discusses fisheries development with Lamakera and the rights-based approach that has been developed to enforce regulations and support economic stability. It is worth noting that the manta ray trade is part of the larger mobulid fishery (mobulids include both manta rays and mobula rays). The mobulid fishery is referenced in this document to add context where necessary. However, the present case study focuses primarily on manta rays.

1.1 Description of the fishery

Lamakera location and demographics

Lamakera in East Flores, Indonesia, is infamous as one of the world's largest targeted mobulid fisheries, where thousands of mobulids are landed annually to supply the global demand for mobulid products. Manta rays comprise the majority of Lamakera's targeted mobulid catch, but both manta and mobula rays are hunted, primarily for their gill plates (or branchial filaments). These body parts fetch a high price in the Non-Traditional Chinese Medicine market. Manta meat is a by-product and provides a secondary source of income to this community. Historically, Lamakera hunted manta rays on a subsistence, artisanal scale for hundreds of years. However, in the last two decades, this fishery developed as a commercially-driven fishery; fishing activity has since had a devastating effect on the populations of these vulnerable species in the surrounding waters.

Lamakera is located on the east coast of Solor island, East Flores Regency, East Nusa Tenggara Province. The village is divided into two smaller villages - Motonwutun and Watobuku. The total population is 2 504, and there are 661 households. The total land area is 162 hectares. The arid land makes farming impossible and, consequently, marine resources are the main source of income and food. There are 345 fishers in Lamakera (13% of population), and these fishers earn 71 percent of the community's income (Table 1).

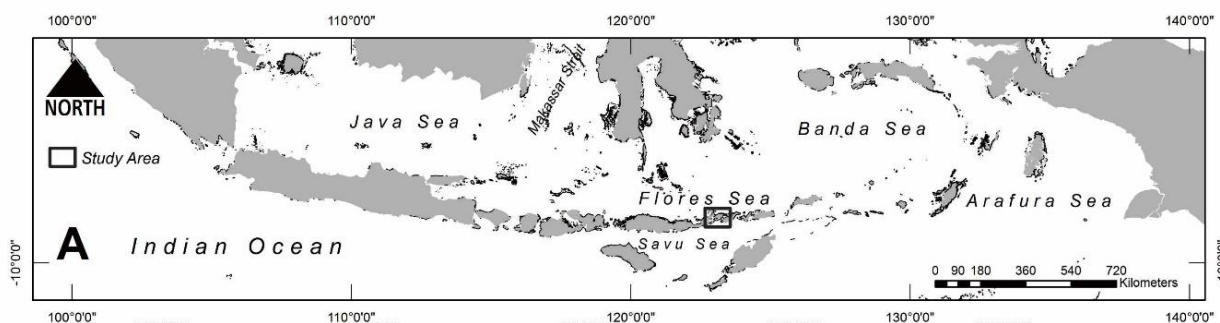


Figure 1. Lamakera's location within Indonesia.

Table 1. Demographic data from Lamakera.

Demographics	Watobuku	Motonwutun
Percentage of under 20 years old	51%	38%
Percentage of population earning income	19%	20%
Percent of income earners who are fishers	75%	90%

Data source: social survey carried out in 2014 by Vanessa Jaiteh.

The manta ray hunting season lasts for eight months, from March to October inclusive. The peak month for manta landings is July. From January to March, the area experiences seasonal rain, making it impossible to dry the gill plates. High winds and waves make the ocean impassable.

Mantas are hunted using traditional spearing techniques. In addition to targeted hunting, the use of gill nets has increased in the last five years, and mantas are now threatened by accidental and

intended catch in these nets. Until recently, spearing manta rays made up a substantial part of Lamakera's income, however, fishers also use a variety of fishing techniques including bottom-set gillnets, drift gillnets, bottom and pelagic longlines, handlines, trolling, and bombs, targeting different pelagic fish species such as tuna, sardinella and mackerel.



Figure 2. Fishing grounds of Lamakera fishermen.

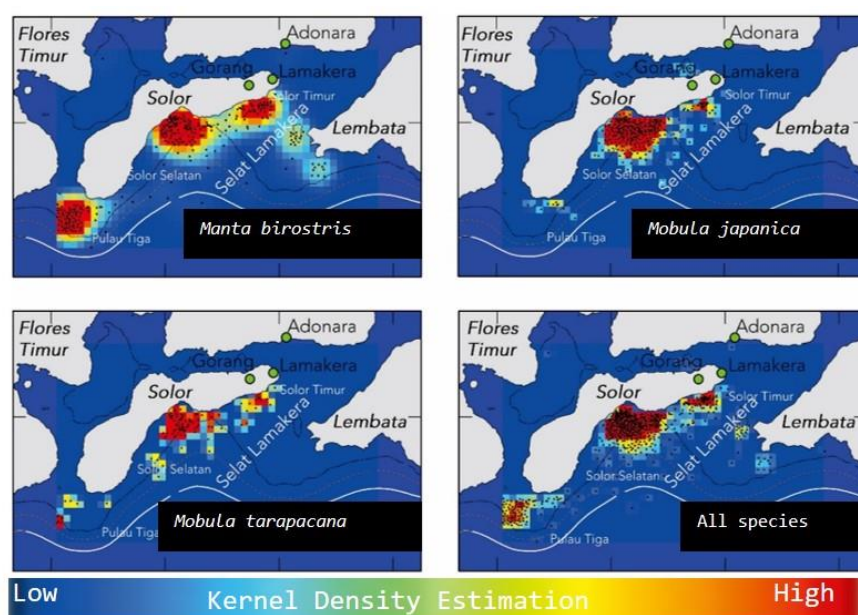


Figure 3. Mobulids fishing ground map.

Source: Mobulids landing conducted by Iqbal Herwata (2018).

Manta Fishery structure

The manta fishery is structured as follows:

- Fishers and boat owners/captains: One fishing boat normally consists of one captain and five to ten crew members
- Papalele: Papalele are the fish collectors, primarily women, whose role is to buy the catch from the fishermen, process the manta gill plates and meat and sell to buyers
- Middlemen: Many middlemen are located within Lamakera, and they sell the dried gill plates directly to the external traders
- Traders: Buyers, the majority of whom are in Java and Bali, who are responsible for sales and export to China and other Asian countries

The gill plates are sent to Surabaya, Java, and then exported to China. The lower value meat is sold locally. Processed fish and fresh yellowfin tuna and skipjack are exported to the USA and Japan by three fish factories (Okishin, Primoindo, and Jasa Putra Abadi).

Manta Fishery Supply Chain

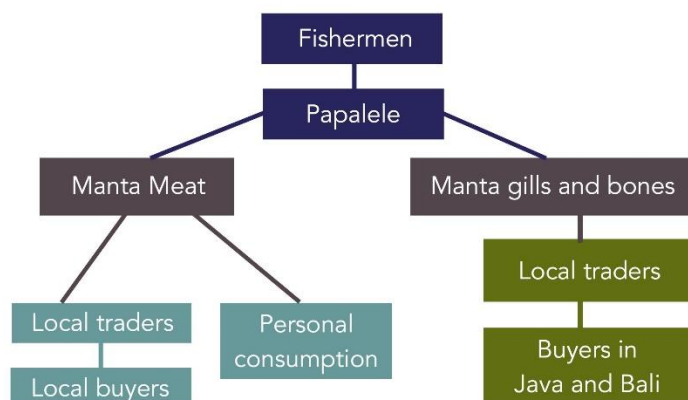


Figure 4. Supply chain diagram.

Source: based on the draft Indonesia Marine and Climate Support report by USAID of NTT.

Economic contribution and social implications of the fishing activity

The international trade in manta ray gill plates is worth around USD 10 million annually, and Indonesia is one of the largest global manta fisheries (O'Malley et al. 2016). Data from Lamakera shows that in 2013-2014, 94.5 percent of 212 mobulid fishing trips were profitable, with 76 percent earning over USD 85. Gross revenues from the mobulid trade, based on landing numbers and market prices for dried gill plates and meat, were estimated at USD 295 862 in 2002. Increasing prices for gill plates somewhat offset the declining catches from 2002 to 2014, and overall gross revenues from the mobulid trade fell to less than USD 93 000 by 2014 (Table 2). With the recent reduction in gill plate prices, these revenues can be expected to decline sharply in 2015 (Table 3).

Table 2. Manta Trade Revenue 2002-2014.

Manta Trade Revenue from 2002 - 2014			
	2002	2010	2014
Manta catch	975	228	138
Avg. Yield Meat (kg)	50	50	50
Price/kg meat (US\$)	4	6.9	6.9
Avg. Yield gills (kg)	5	5	5
Price/kg dried gills (US\$)	19	69	10
Total Revenue (US\$)	295,862	157,241	118,965

Source: Lewis et al., (2015)

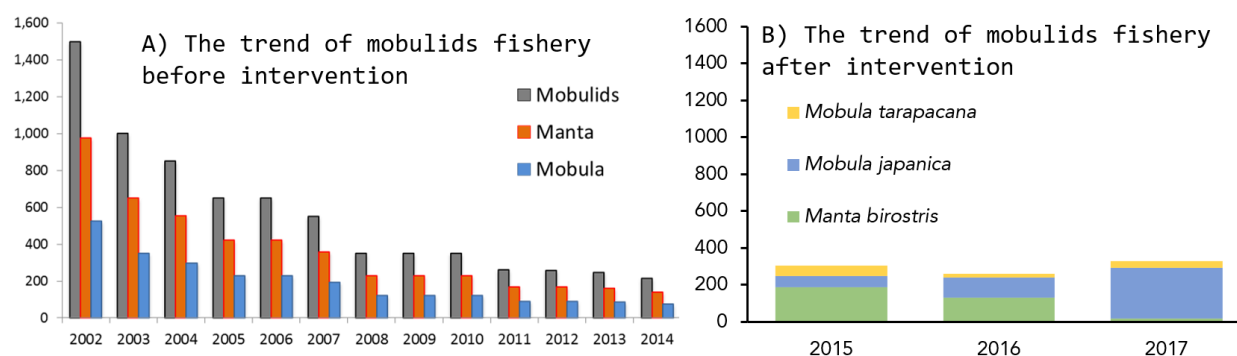
Table 3. Income from Manta Trade 2015-2017.

Income from Manta Trade		
Year	Total Manta Catch	Gross Income
2015	178	US\$ 89,000
2016	75	US\$ 37,500
2017	6	US\$ 3,000

Manta trade income decrease between 2015 and 2017 = USD 86 000

Source: Field data collected by Misool Foundation team (2015-2017) based on average cost of USD 500 per manta.

The Lamakera manta ray fishery landed an estimated 975 mobulid rays in 2002 (Dewar 2002.). Catch comparison across a 12-year period (2002 to 2014) revealed a 75 percent decline in manta ray and mobula catch despite an increased fishing effort (Lewis et al. 2015) (Figure 5). Interviews in 2011 and 2014 revealed that fishers found it increasingly difficult to locate mantas, further suggesting that populations may have declined significantly due to fishing pressure. Despite recognizing the fact that stocks may be depleted, there was no effort from the fishermen to reduce hunting efforts.

**Figure 5. Annual trends of mobulids fishery in Lamakera.**

X-axis indicate the total numbers of mobulids caught annually.

Source: A) data based on Lewis et al., (2015); and B) Putra and Lewis, 2018a.

Note: graph (A) shows that before the intervention, fishing efforts for manta rays is higher rather than mobula, but after the intervention in graph (B) the species composition has changed due to the decrease in manta hunting effort. Additionally, the gillnet fishery effort has increased, leading to an increase in mobula landings.

The social effects of the fishery can be felt in several ways. Continuing to practice manta hunting puts fishermen at risk of arrest. Furthermore, the fishery supports a debt cycle that affects many residents. Our field team have observed that traders typically provide loans to fishermen and other community members, often in times of hardship or emergencies. This leaves the fishers indebted to the traders, both financially and personally, meaning that the fishers must continue hunting to repay these loans. Finally, unsustainable fishing practices have the potential to impact the future food and livelihood security of this community, which is reliant on a healthy marine ecosystem, making the expansion of sustainable fisheries more critical each day.

2. MANAGEMENT OF THE FISHERY AND RIGHTS-BASED APPROACH

2.1 Management of the fishery

In 2014, the NGO coalition began working with the Indonesian Ministry of Marine Affairs and Fisheries, local government and coastal villages to introduce a comprehensive, community-based conservation program designed to collect scientific data, influence marine policy and diversify livelihoods within the

community. In 2016, realizing the need for a local enforcement component to complement the community work, the Wildlife Conservation Society's (WCS) Wildlife Crimes Unit (WCU) was brought in to begin a local patrol initiative. This multi-faceted approach is described in more detail below.

Government

The Department of Fisheries is responsible for official regulations such as boat licenses, fishing licenses and authorising marine patrols.

Regulations

- Minimum mesh size for purse-seine fishers (≥ 1 inches)
- Banning of destructive fishing such as bombing, compressor diving, manta hunting
- 0-10 GT boats permitted to fish in the region (East Flores) or 0-4 miles from the coast
- 10-30 GT boats permitted to fish 4-12 miles from the coastline and permitted to land catch in province harbours with official authorisation letters

Quotas

No quotas have been developed for the sustainable hunting of manta rays. All hunting is banned, and manta ray experts and leading marine scientists agree that mantas cannot be fished sustainably due to their very low reproductive rates, small population sizes and other life history traits.

Zonation

The Savu Sea area (within which East Flores is located) is reserved as a Marine Protected Area (MPA). However, since it has been established, management has been limited. Additionally, East Flores is not currently included in any of the MPA zonation plans. In 2018, the East Nusa Tenggara Governor declared the intention to create zonation for fisheries and conservation areas. This policy aims to create zones for small and large fisheries and usage of fishing gear. However, the province currently lacks the systems, human resources and budget to manage this area, which spans 700 islands and 15 million hectares. The Misool Foundation has been working in an advisory capacity to provide recommendations for MPA policies (Figure 6).

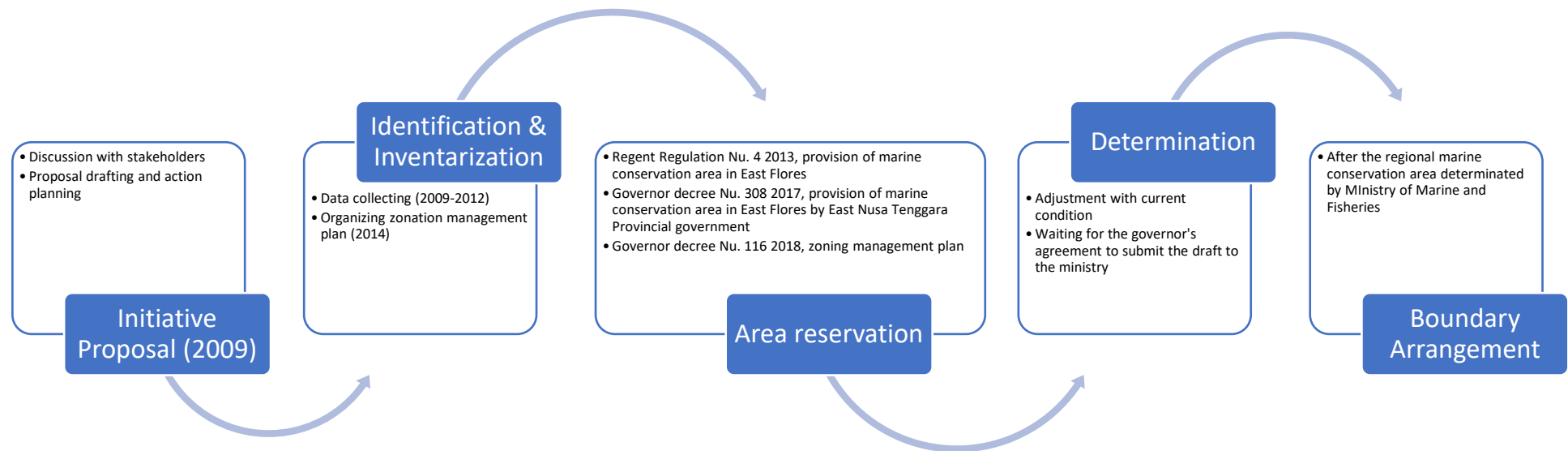


Figure 6. East Flores MPA planning process.

Enforcement

Despite the initial efforts to transition Lamakera away from illegal manta hunting using only a community-based conservation approach, some manta hunters found the temptation to continue hunting mantas to be too strong. To ensure that this already severely depleted manta population does not become extirpated, it was imperative that immediate action was taken to stop the remaining hunting activities. In the first two years since the manta law was passed, WCS and their marine WCU actively pursued arrests of key manta gill plate traders around the country, including an important arrest in Lamakera in July 2015. That arrest, in particular, caused a significant backlash against our team on the ground in Lamakera. At that point, we began intensive discussions with WCS about the need to initiate an active patrol system designed to stop the manta hunt, with the important caveat that our team on the ground and our community engagement program be kept explicitly separate from the patrol system. WCS and their WCU agreed to take on the implementation of the patrol system, and they began working with the Fisheries Department, Marine Police and Marine Ministry Controller to develop a comprehensive enforcement schedule. This began in September 2016 and patrols are now conducted around 14 days a month, depending on conditions and fishing season. The Misool Foundation research team has developed an environmental model to predict occurrences of large megafauna. This data is used to provide recommendations for priority patrol dates and locations. The collaborative approach aims to change attitudes and norms towards manta ray conservation through community outreach and incentives (both positive and negative).

2.2 Brief history of the former rights-based approaches used in the fishery

Lamakerans have been fishing manta rays, in their words, since ancestry (*sejak nenek moyang*). Until around the late 1990s, they were only fishing mantas on an artisanal and subsistence scale and only used the meat for local consumption; the remaining body parts (including the gill plates) had no value and were thrown away. However, as commercial markets developed and reached Lamakera, buyers told them that they could also sell the skin, bones and gill plates. Since then, every part of the manta is used, and the fishery expanded from an artisanal fishery into a commercially driven fishery with a significant increase in fishing effort.

In the past, it would take Lamakera hunters two days and a night to get to Pulau Tiga (the main manta fishing ground). The boats would spend approximately 15 days at sea and return with a catch of about five to seven mantas per boat. In the late 1990s, government subsidies helped to finance a shift from traditional sailing boats to motorised vessels. The number of boats increased from 18 to 30 boats (M. Songge personal communication 2011, in Lewis et al. 2015). These changes dramatically shortened the journey time to fishing grounds and fishers only needed to fish for a day to yield similar catch results.

The manta ray hunting tradition was based on an internal hierarchy. The spearing captain (the person in charge of the harpoon) comes from a historical lineage of hunters. People not born into such a family will probably never become spearing captains, but they can still spear mantas. Although pride in their skill is no doubt a part of Lamakera's manta hunting, the culture of manta hunting has been lost in recent years, and many Lamakerans admit that it is primarily driven by economic incentives.

2.3 Rights-based approach: allocation and characteristics

This development of a rights-based approach intended not only to give fishermen the ability to voice their needs and concerns but also to encourage ownership of sustainable fisheries management. Embedding the fisheries governance challenge within a broader perspective of human rights enhances the chances of achieving both human development and resource sustainability outcomes in SSFs of developing countries (Allison et al. 2012).

Since the manta hunting ban was introduced, the community has been involved in multiple socialization meetings with the Indonesian Ministry of Marine Affairs and Fisheries, local government

departments and NGOs. These meetings aimed to provide clarity to the regulation, provide a forum for community members to raise their concerns or share their perceptions and start discussions about possible alternative livelihood options.

These discussions were met with mixed feelings from the community. Some felt their income was threatened, while others understood the law and were keen to seek alternative options. The Misool Foundation responded by developing new income streams that are decoupled from manta hunting. We engaged ex-manta hunters and the community members who were ready to change. Our priority was to give them the option to stop hunting in exchange for NGO and government support. We gathered those people and asked them to sign an agreement to state that they would stop hunting mantas, an agreement ratified by the local government departments. In return, and with consultation from the fishermen, we completed several surveys to understand how we could best address their needs. We invited Indonesian-based non-profit organization, Yayasan Masyarakat dan Perikanan (MDPI) to conduct a Rapid Assessment on the Potential for Sustainably Focused Program Development in Lamakera.

The assessment concluded that most of the Lamakeran fishers are opportunistic and take multiple gears with them on their fishing trips. This assessment showed that fishers were open to new methods, therefore giving the potential to explore other options such as the development of new supply chains of high-value species like skipjack tuna and high-value demersal fish (MDPI Survey 2016).

POKMASWAS “Ocean Rangers”

The effects of manta hunting are felt by the wider community, and these communities were encouraged to take an active role in protecting their own marine areas. To further this, the Misool Foundation team worked with the government to reestablish the POKMASWAS groups. POKMASWAS is a government-supported entity that is supported to become a local community ambassador network for the marine environment.

In September 2016, we organized POKMASWAS training and socialization events. These were attended by residents from five districts. We also launched a call center to provide a mechanism to report IUU fishing and incidents of vulnerable and protected species – those caught as bycatch or those that were stranded. Along with the Fisheries Department and the WCS, we set up a rapid response team to respond to these reports.

This initiative yielded impressive results, and in May 2018, the Misool Foundation expanded the POKMASWAS group to include 39 participating villages. Since then, the number of bycatch reports has increased significantly. In 2016 and 2017, we received an average of 2.5 reports per month. In 2018, this has grown to an average of four reports per month. This year we have released 27 large, vulnerable marine animals, including manta rays and whale sharks.

Cooperative Development

In 2016, we developed a fishermen’s cooperative as an economic device, to support the fishers’ transition away from hunting manta rays. By January 2018, 26 ex-manta hunters and a total of 93 community members had joined the cooperative. The main stipulation of cooperative membership is that all members will sign the official agreement to stop hunting.

The cooperative is registered with the Department of Cooperatives and is a legal entity. This means that members receive support and training on financial management and reporting. Additionally, the cooperative is eligible for grants from the local government.

Based on interviews with the community and survey results, five small business units were established within the cooperative framework; microfinance, community minimarket, ice production, seaweed farming, and a mini purse-seine boat.

Microfinance

Our microfinance unit, which is available for the cooperative members, sets low-interest rates for loans and high-interest rates for savings to help members to develop their livelihoods and stimulate savings. Since this program began, 48 people have received loans, and 60 people have started saving. Seventeen recipients, with an average loan amount USD 314, have used their loans to start small enterprises such as restaurants and shops. Loans are also used to buy equipment, provide extra capital to buy fish and to improve household water supplies. Anecdotal comments from the community are positive, and recipients are pleased to receive investment capital to improve livelihood options.

Ice Production

One obstacle for Lamakera fishers is the lack of consistent ice supply, which makes it difficult to preserve catch quality. The ice production unit was developed to provide good quality ice service to Lamakera and the surrounding villages, in order for them to attain a higher price for their catch on the market. The ice service began operating in March 2018 and has several regular customers.

Community Mini-Market

The Community Mini-Market meets the needs of cooperative members by selling households goods at competitive prices and reducing the costs of travelling to the mainland to buy these goods. Cooperative members receive preferential rates and can pay for their purchases on an instalment basis. Along with the economic benefits to the community, this has become an effective tool to recruit more cooperative members, therefore ensuring more people sign the agreement stating they will not continue to hunt mantas or trade their body parts.

Mini Purse-Seine Fishing Boat

The Mini Purse-Seine fishing boat is designed to be a high-income business unit. This fishing boat is the largest mini-purse seine in the area, and the design ensures that the target species are sustainable (as per recommendations from the Fisheries Department and WWF-ID). This boat is not suitable for catching mantas and large marine mammals. There are eight ex-manta hunters in the crew.

Seaweed Aquaculture

Seaweed is one of highest value marine products, suitable for development in the East Nusa Tenggara waters. A lack of seeds and environmental data to support seaweed farming development has led to an absence of farms in East Flores.

To address this, we signed an MOU with Artha Wacana Christian University Kupang (UNKRIS) in July 2018. Together we will conduct research on the ideal species and environmental conditions for local seaweed farming. UNKRIS will collect data and train cooperative members on farming techniques.

Training

Developing new skills is an important part of achieving long-term success in livelihood diversification. Since May 2017-2018, we have held 23 training sessions for 40 cooperative members.

3. CONTRIBUTION OF THE RIGHTS-BASED APPROACH TO ACHIEVING SUSTAINABILITY

3.1 Sustainable use of the resources

Manta rays are a large, slow-growing, long-lived species, with extremely low reproductive rates, which makes them particularly vulnerable to overexploitation (Dulvy et al. 2014). However, little data still exists globally on population numbers and migration patterns.

Anecdotal evidence of local manta population extinctions at several locations throughout Indonesia (in some cases due to even very minimal fishing pressure) further highlights these species' extreme vulnerability to fishery pressure. However, the highly migratory nature of these species and lack of data on the population ecology of mantas in Indonesia and throughout their range makes it difficult to determine whether natural fluctuations might be playing a part in the declining catch per unit effort in Lamakera, and understanding to what extent the current level of exploitation is affecting regional populations (Lewis et al. 2015).

Numerous studies on these species indicate that it is extremely likely for manta rays found off Lamakera migrate to other parts of Indonesia, possibly crossing international borders. Manta rays are extremely valuable as a living resource to the dive and snorkel tourism industry globally, with Indonesia being the second most valuable manta tourism industry in the world (O'Malley et al. 2013). As such, Lamakera's hunting could have a severe impact on the livelihoods of the many people in Indonesia who rely on manta tourism and a healthy marine environment. A key aspect in ensuring the continued recovery and preservation of this population is understanding movements and threats in areas outside of Lamakera.

Despite initial challenges, our monitoring data shows that manta catch was reduced by more than 90 per cent between 2015 and 2017. These encouraging results provide evidence that our two-pronged approach to enforcement and livelihood development is working. Additionally, increased interest in and membership sign-up to the fishermen's cooperative proves that behaviour change is occurring at a local level, also demonstrating that community members have an increased understanding of the need to transition to new fishing practices.

3.2 Economic viability of the fishery

Since partnerships were built with the Fisheries Department and other related departments, the community began to receive grants from the local government and Misool Foundation. So far, fishers have received 20 small boats, an ice production machine, scholarship for fishers' children, and microfinance capital to help them to develop alternative livelihoods. Mentoring and skill development are carried out continuously so that communities can become independent.

The community business units are structured in a way that enhances existing incomes, lowers household costs and – in the case of the mini purse-seine fishing boat– provides a higher income by using alternative fishing methods. Ice production and more cool boxes mean that the fishers can increase the value of existing catch in a simple way without having to increase catch numbers. The cooperative is legally recognized and has clear management system, with targets issued by the government.

The Community Mini-Market reduces household costs and allows the cooperative members to purchase goods on a payback system. This is particularly important as it reduces the need for community members to take out high-interest loans from traders, thereby breaking the debt cycle. In addition, the mini-market has begun working with distributors to increase the effectiveness and profitability of their small businesses within the community.

The income projections for the mini purse-seine boat show the potential to become more economically viable than manta hunting. Operational costs from this fishing method are significantly lower than manta hunting expenses, creating a greater pool of available profit for fishermen. The high season for fishing pelagic fish is March to October when fishermen can make up to 14 days fishing trips per month. Per trip, our projection show that fishers could yield around USD 1 680) with only USD 160 in operational costs.

3.3 Social equality

The women within the fishery (papalele) are an integral part of the system. The main motivation for women to work as papalele is the opportunity to boost their husband's income and improve family wellbeing and financial stability. The papalele form small groups or alliances of around four women, working together and sharing profits from a boat. There are two ways in which they sell the fish – either by taking fish from the fishermen and paying after they have sold. This method results in a narrow margin of profit (around 17%). Sometimes, the women have enough funds ('modal') to pay the fishers directly and then sell the parts, keeping all the profits (Jaiteh 2014). To assist the papalele in becoming more financially independent, our microfinance loans give them more options to grow their business and buy fish outright, therefore generating more profit.

4. MAIN CHALLENGES AND WAY FORWARD

4.1 Challenges for the fishery

In the East Flores region, Lamakera is the primary supplier of mobulid products to the local and international market. As such, they dominate the market and have no interaction with large-scale fishers who target different species. Lamakera fishers also use gill nets or small purse seines to catch sardinella, mackerel, skipjack and yellowfin tuna with 0-5 GT boat. The neighbouring fishing communities use purse seine boats that have larger nets and boats (10-20 GT) and catch the same pelagic species as Lamakera fishermen. The pole-and-line fishers from Larantuka also catch mackerel and sardinella for tuna fish bait, which competes with Lamakera. As a result, fishers find it increasingly difficult to get sardinella and mackerel.

Community transition to a new industry can be extremely difficult, especially in a place like Lamakera where the manta hunt is not just a source of income for locals but the source of their identity. Transitions of this nature take a great deal of time. Based on the Environmental Defense Fund program on Chilean National Benthic Resources Territorial Use Rights for Fishing Program, it took more than ten years to implement TURFS for Chile's highest value mollusc species. Since this implementation, landings have increased five-fold, the mean sizes of individual organisms have increased, catch per unit effort is up and some fishing organizations have established no-take zones to enhance spawning within their TURF (Environmental Defense Fund).

Some members of the Lamakera community are still opposed to the regulations and often attempt to influence public opinion, citing that the regulation is infringing upon their rights to practice their tradition. Lack of respect for the rule of law, combined with the minimal punishments handed out for the most egregious fishing tactics, continue to provide challenges to transition Lamakera away from hunting mantas.

At the government level, fisheries management still needs to be improved. Overlapping inter-institutional obligations are not accompanied by multi-sector cooperation in the management of fisheries and marine resources. This results in ambiguous management policies that are not applied properly. Fishery management still needs co-management from other stakeholders (NGOs and other organizations). While the motivation to extend the Savu Sea MPA to include East Flores is strong, political and legal issues are the most challenging factors for fisheries in Indonesia. Ministerial reshuffles, legislative elections and policy and leadership changes make it difficult to implement new policies in an effective and timely manner.

Declining catch numbers have been recorded not only for mantas but also pelagic fish such as yellowfin tuna, skipjack, mackerel, and sardinella. Data from the East Flores Fisheries Department in 2016 and 2017 shows that the landing numbers of yellowfin tuna, skipjack tuna mackerel and sardinella had declined by 15%. Interviews with the Fisheries, Marine Management Departments and fishers

revealed that fishers need to travel further to catch fish. There is currently no stock assessment or Harvest Control Rate (HCR) survey in this region.

4.2 Improving fishery sustainability in the future

As economics drive manta hunting and there are no quotas for manta hunting, the development of alternative sources of income is critical to address the economic threat to the Lamakeran community, which is largely dependent on unsustainable use of declining resources.

Data collection and legal fishing rights

Comprehensive stock assessments need to be carried out in the region. Previous data must be collated, and the local government needs to develop an archiving and management system to track fisheries and changes in fish stocks.

Management of fishing activities should include output control of the catch and input control, including fishing efforts. To formulate a policy on the utilization of fisheries and realize sustainable fisheries management in East Flores Regency, data collection and analysis of the Harvest Control Rules (HCR) should be carried out for species of fish that are predominantly targeted. This data should formulate a fisheries management action plan for the target species. In a place like Lamakera, one of the fisheries management systems that can be tried is TURFs. Territorial Use Rights for Fishing programs, or TURFs, allocate secure, exclusive privileges to fish in a specified area to groups, or in rare cases individuals. Well-designed TURFs have appropriate controls on fishing mortality and hold fishermen accountable to comply with these controls. TURFs tend to be a valuable approach for curbing the overfishing problem in places where government resources are limited. They empower local fishermen and communities to control and steward their own fisheries through a solid system of fishing rights, responsibilities and rewards. Well-designed TURFs have appropriate controls on fishing mortality and hold fishermen accountable to comply with these controls (Environmental Defense Fund 2018).

Zonation

Even though the regional government has reserved 150 000 hectares for marine conservation, this cannot be executed before the ministry decree for the East Flores MPA is issued. This means that it is on hold until 2019. While delays can be problematic, this is the ideal opportunity for multi-sectoral stakeholders to collaborate and ensure that rights-based approach principals are incorporated into the MPA design. This will have the overall impact of balancing natural resource sustainability and improving the community's economic life.

Sustainable fisheries

Further programs are needed to provide sustainable fishing gears and, to assist the community in converting to sustainable fishing, techniques such as handline tuna fishing and mini purse-seine fishing are needed.

Additionally, an urgent assessment of the impact of the gillnet fishery in the region needs to be presented to the government with a view to issuing bans or restricted fishing areas for this type of fishing gear. Many fishers from this region are using gillnets, including Lamakera, and our catch records and initial assessments of this fishery in East Flores has revealed significant manta ray catch and frequent entanglement of other vulnerable and protected species such as turtles, whale sharks and dolphins. Although many fishermen report that the manta catch is unwanted and accidental bycatch, they are still landing and selling this catch, indicating that it is not necessarily unwanted but rather a valuable secondary catch.

Our primary long-term goal for addressing the gillnet threat is twofold: first, to work with the East

Flores government to ban the use of gillnets within the proposed East Flores MPA; and second, to help the communities transition to sustainable fishing gears. As this transition may take a long time, our team is currently experimenting with ways to reduce bycatch. We know that using different color LED lights on the gillnets can help to discourage megafauna from entering the gillnets and that the 'right' colored lights would theoretically do so without interfering with the fishermen's primary catch.

Collaboration from multi-sectoral stakeholders

There is a need to change the perception that fisheries management is the sole responsibility of the fisheries department. Cooperation from multi-sector stakeholders, such as community, tourism services, transportation, environmental, public infrastructures, health, and the economy is required to ensure effective management of the fishery. Each stakeholder has responsibility for fisheries management based on a rights-based approach in the field. Coordination with all parties will ensure that the implementation of fisheries management is aligned and not overlapping. Monitoring and evaluation should be carried out for measuring the success of implementation.

Law enforcement

The Indonesian government should be commended for its efforts to conserve manta rays by prohibiting the catch of these species. However, lack of law enforcement staff and sustained funding will become a problem to law enforcement bodies. More specifically, ongoing marine patrols are dependent on budget allocation from the government. In 2018, the Region of East Flores had allocated USD 100 000 for surveillance vessels and thousands of dollars for operational costs in 2018. This will provide a good foundation to migrate responsibility from third party management to the government management of marine patrols. Better collaboration between several enforcement teams (marine police, navy, fisheries department) through establishing an integrated team could be a good strategy for developing sustainable marine patrols. A tactical strategy is needed to further the implementation of penalties. Currently, the process is complicated, and, in the case of manta landings in Lamakera, prosecutions are often impossible because the evidence that is collected does not satisfy the legal requirements for prosecution. Furthermore, sensitivities and conflict surrounding the manta law in Lamakera make it challenging and dangerous for local law enforcement to enter the community after reports of manta landings. Compounding this it is the stigma around the notion of arresting 'poor' fishermen. This mindset has made law enforcers reluctant to follow through with arresting fishermen. Strategies to improve manta law enforcement in Lamakera are therefore critical in ensuring the sustainable future of fisheries in East Flores.

Supporting sustainable alternative livelihoods

Community-based conservation that involves the community in conservation management programmes and provides benefits to the community will provide a good channel to achieve long-term success in biodiversity conservation. Development and socialization of alternative sources of income and educational facilities for Lamakera will be critical in ensuring community acceptance and compliance with conservation measures. Support should focus on enabling these communities to become financially independent. Additionally, success in this area could lead to recognition and mirroring behaviour from other community members, as they observe evidence that they do not need to hunt mantas to earn an income.

Demand

Finally, despite a lack of comprehensive data on sales and consumption across consumer markets, the continued targeting of mobulid rays, and the reported rise in consumption in Hong Kong in 2016 (O'Malley et al. 2016) indicate that the international market for mobulid gill plates has not collapsed.

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