

Examining local conservation and development: Live reef food fishing in Spermonde Archipelago, Indonesia *

*Conservação e desenvolvimento local: recursos pesqueiros no Arquipélago de Spermonde na Indonésia ***

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ABSTRACT

Live reef food fish (LRFF) fishing is one of the most important livelihoods for the people of the coastal and small island communities within the Spermonde Archipelago in South Sulawesi Province of Indonesia. However, LRFF fishing and trade is considered a threat to the reef ecosystem due to over-fishing and the use of cyanide as a method of increasing the LRFF catch. This paper examines the effectiveness of a development and conservation effort known as COREMAP (Coral Reef Rehabilitation and Management Project), which was funded by loans and grants from various international financial institutions and overseas development agencies that aim to protect, rehabilitate, and sustain the utilization of coral reefs and their associated ecosystems in Indonesia. In this paper, COREMAP is examined in order to answer the main research question, “Has the lack of understanding of the socio-economics of the LRFF fishing and trade been a factor in the shortcomings of COREMAP to protect, rehabilitate, and sustain the utilization of coral reefs and their associated ecosystem in Indonesia?” This paper demonstrates that the achievement of COREMAP’s goals has been hindered by COREMAP’s inability to incorporate commoditization processes characterized by profit accumulation in the hands of a few actors and by the persistence of debts structure through the existing LRFF fishing and trade networks into COREMAP’s strategies and policies. Moreover, this paper also demonstrates that COREMAP’s organizational structures have not been able to challenge the practices of corruption which maintain cyanide fishing practices, characterized by the existing LRFF prosecution insurance network. This paper concludes that the inability of COREMAP to clearly address the issues of profit accumulation and debts as well as to challenge the practice of corruption have led to shortcomings in the achievement of COREMAP’s conservation and development goals. The case of managing reef fishery in Indonesia provides valuable lessons for countries with abundant reef ecosystem and for international development agencies which support the conservation and development of coastal areas.

Keywords: Live reef food fish (LRFF); COREMAP; social networks; conservation; Spermonde Archipelago; cyanide fishing.

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RESUMO

A pesca nos recifes é um dos mais importantes meios de subsistência para as comunidades costeiras e das ilhas no arquipélago de Spermonde na província Sulawesi no sul da Indonésia. Contudo, a pesca e o comércio dos recursos biomarinhos pesqueiros é considerada uma ameaça aos ecossistemas recifais devido à sobrepesca e ao uso de cianeto para aumentar as capturas. Neste trabalho avalia-se o sucesso de um plano de desenvolvimento e conservação, o COREMAP (Coral Reef Rehabilitation and Management Project), financiado por empréstimos e apoios de várias instituições financeiras internacionais e agências de desenvolvimento, com o objectivo de proteger, reabilitar e implementar o uso sustentável dos recifes de coral e os ecossistemas associados. O COREMAP é avaliado no sentido de responder à questão investigativa “A ausência de conhecimento e compreensão dos factores socioeconómicos relativos à pesca e comércio dos recursos biomarinhos pesqueiros constituíram factores negativos na aplicação dos objectivos do COREMAP?” Este estudo demonstra que os resultados e execução do COREMAP foram prejudicados pelas deficiências na incorporação dos processos de mercantilização e a acumulação dos lucros junto de poucos dos envolvidos, persistindo ainda uma dinâmica de débitos nas redes comerciais associadas às estratégias e políticas do COREMAP. Além disso, o COREMAP não teve êxito em impedir as práticas associadas ao uso de cianeto para aumentar as capturas. Concluímos que o COREMAP não atingiu os objectivos de criação de riqueza e equilíbrio económico, assim como não conseguiu impedir as práticas lesivas do ambiente associadas a dinâmicas sociais inadequadas e impeditivas de desenvolvimento socio ambiental. O caso da pesca recifal na Indonésia é referencial para países com grandes ecossistemas recifais e para as agências internacionais de desenvolvimento que apoiam e suportam a conservação e o desenvolvimento das áreas costeiras.

Palavras-chave: Recifes; Pesca; Redes socioeconómicas; COREMAP; Arquipélago de Spermonde; cianeto.

1. INTRODUCTION

Live reef food fish (LRFF) is the term used for fish that are kept alive until cooking in order to preserve their freshness (Radjawali, 2011). LRFF fishing and trade is the process of catching the fish from the sea and trading them through different middle men until they reach the end consumers in, for example, Hong Kong and China. LRFF fishing is one of the most important livelihoods for the people of the coastal and small island communities within the Spermonde Archipelago in South Sulawesi Province, Indonesia. Johannes and Riepen (1995) estimated that in 1995, Indonesia supplied half of the market demand of LRFF in Singapore and Hong Kong, while Cesar *et al.* (2000), citing Bentley (1999), estimated that the total export of LRFF from Indonesia is 27,000 tons per year. With demand so high and the relatively high price, LRFF fishing and trade is considered to be a lucrative pursuit among many local communities.

Different techniques and tools are used in LRFF fishing. Cyanide fishing has become the most prominent method due to its effectiveness in increasing catch (Radjawali, 2011). However, debate on the impact of cyanide fishing to the reef ecosystem is still continuing. Johannes and Riepen (1995) argued that cyanide use to stun fish is causing severe reef degradation, while Mous *et al.* (2000) reported that the impact of cyanide fishing on the coral cover is not as threatening as is often assumed, particularly compared to the deleterious impact on coral reefs due to blast fishing or coral bleaching due to global climate change. Berkes (2002) reported that laboratory experiments have shown that the toxic effect of cyanide under experimental condition has not been proved as severely degrading reef.

Nevertheless, an even more severe problem in the LRFF trade is the over-exploitation of LRFF. For example, the grouper (Family Serranidae) spawning aggregation sites, which are easily located by fishermen because of the groupers' life-history characteristics (longevity and size-dependent sex change) put this fish stock extremely vulnerable to over-exploitation (Mous *et al.*, 2000). The LRFF trade is behind

much of the over-exploitation of the coral reef fish population (Johannes and Riepen, 1995; Bentley, 1999; Lau and Parry-Jones, 1999; Sadovy *et al.*, 2003; Scales *et al.*, 2007).

Different initiatives have been established to combat the economically and environmentally unsustainable fishing practices in the region by integrating the environment into development projects. One such project is the Coral Reef Rehabilitation and Management Project (COREMAP). However, with only a year left of implementation, the practice of cyanide fishing as one of the possible drivers of reef ecosystem degradation and also might lead to overfishing is still endemic. As argued by Dias *et al.* (2012), a sustainable coastal zone management is a difficult task, due to its requirements of profound interdisciplinary knowledge as well as the correct determination of causes and consequences.

Any path to sustainable forms of governance of the LRFF trade needs to explicitly acknowledge the gap between policy and practice (Fabinyi and Dalabajan, 2011). A critical examination of COREMAP's effectiveness is needed in order to provide some insights for future internationally funded projects. There are at least two reasons why this examination is important. Firstly, greater understanding is needed to explain why cyanide fishing is still prominent thirteen years after the establishment of COREMAP. Secondly, there is a need to identify and narrow the gap between policy and practice in the governance of LRFF trade in Indonesia, a problem that has not been given much attention. Furthermore Fabinyi and Dalabajan (2011) highlight that the governance of fisheries is not only about crafting better policy, but also about dealing with complicated local social contexts in order to implement those policies. This paper analyzes findings from ethnographic and interdisciplinary study on complex local social contexts of LRFF fishing and trade in the Spermonde Archipelago in Indonesia. This analysis would arguably give important insights to narrow the gap between policy and practice in fisheries governance (e.g. the gap between how COREMAP was envisioned and how COREMAP is actually practiced).

After this introduction, the paper briefly describes a background of the field site and methods used. The paper then examines the literature that has reported activities and achievements of COREMAP in Indonesia. Following this examination, the primary section of the paper then elaborates the LRFF commoditization through networks of actors in Spermonde Archipelago, South Sulawesi, Indonesia, arguably the hotspot of LRFF fishing and trade.

2. MATERIALS AND METHODS

The main geographic area of study for this project is the coral reef-based ecosystem of the Spermonde Archipelago in South Sulawesi, Indonesia (Figure 1, A), which is located between 119° 6' 52 E and 4° 52' 32 S and extends about 60 km offshore (Figure 1, B). The Spermonde Archipelago consists of approximately 150 islands with fringing reefs as well as a large number of barrier and submerged patch reefs (Tomascik *et al.*, 1997). This area is broadly known as the center of LRFF operations in the eastern part of Indonesia, and is supported by the mainland city of Makassar, which is the nearest gate to the international market (see Figure 1, A).

The material for this paper are drawn from the data gathered during the several fieldworks focusing on the recent practices of LRFF fishing and trade. Data collection on LRFF fishing and trade was carried out between November and December 2007 and between February and May 2008 through observations on two islands: Barrang Lompo and Badi (Figure 1, B). In the first stage of fieldwork of 47 days, reconnaissance study was carried out through series of discussions with various researchers and experts from Center for Coral Reef Research (CCRR) of Hassanuddin University in Makassar, Indonesia and visits to two islands where qualitative data were collected. The second stage of fieldwork of 68 days was started by orientation workshop at Hassanuddin University in March 2008, which included some researchers and experts from the CCRR as well as some undergraduate and post-graduate students from the Faculty of Marine and Fisheries, and Department of Anthropology. Following the workshop, 15 students participated in fieldwork in Barrang Lompo island for a total of 14 days where a questionnaire was administered to 300 fishing households. A two days boat trip was also undertaken to the reefs in Spermonde water known by the local fishermen as one of the fishing grounds.

In March 2009 and May 2009, two joint ship-based research excursions to the Spermonde Archipelago was carried out to the islands of Bone Tambung, Karanrang (Figure 1, B), and Saugi. The research team consists of 20 Indonesian and German researchers and students of anthropology, sociology, geography, political science, regional planning, fisheries economics, philosophy, communication studies, and reef ecology (Glaser *et al.*, 2010a). These problem-focused, interdisciplinary research excursions took a mixed-methods approach, based around the active participation of local residents and resource users as well as rapid rural appraisal techniques. In-depth interviews on socio-economic, socio-political, historical aspects of the island and social networks were carried out with 20 interviewees.

Following the excursion, in April 2010 and May 2010 a research team consists of 15 Indonesian and German researchers and students carried out visits to the islands of Barrang Caddi, Badi, Bone Tambung, Karanrang (Figure 1, B) and Saugi. This research aimed at cross-checking the information and disseminating the research findings from previous researches to the island communities. During the 9 days visit, a questionnaire was administered to 123 interviewees where qualitative data were collected. A separate 5 days fieldwork to the island of Sarappo Lompo (Figure 1, B) was undertaken with focus on the commodification of LRFF. Four students were involved in undertaking participant observation, in-depth interviews and role playing game with various LRFF middlemen and fishermen.

Particular focus has been given to the understanding of the role of human-agents (fishermen, patron, middlemen) in LRFF commodification through LRFF networks until they reach Hong Kong. However, due to the time and financial constraints, the middlemen and other actors beyond Spermonde Archipelago and Makassar are excluded. Data on LRFF fishing and trade are collected through the use of five role-playing games with fishermen and *punggawa* (a middlemen for fish, hereafter referred to as patron); participatory mapping with fishermen and patrons; and eight in-depth interviews with patrons. Data collection methods on LRFF fishing and trade during various fieldwork trips included ethnographic observations and interviews with three Makassar-based fish traders, two government officials, seven university-based researchers, and representatives of a non-governmental organization (*Konsorsium Mitra Bahari* / Consortium of Marine Partnership), all of whom are involved in LRFF fishing and trade issues. The majority of data presented in this paper is qualitative while some part of this paper also draws on some of the quantitative questionnaire data.

3. RESULTS AND DISCUSSION

The primary goal of COREMAP is to protect, rehabilitate and achieve the sustainable use of coral reefs and their associated ecosystems in Indonesia, which is in turn expected to enhance the welfare of coastal communities (IUCN, 2002). COREMAP is a 15-year project funded by several sources (see table 1) through loans, a funds made available that carry repayment (The World Bank, 2012b) and grants, funds made available for implementation of development activities that carry no repayment obligation when utilized for the agreed activities (AidFlows¹). The development objective of COREMAP is to develop a viable coral reef management system in Indonesia in order to place the community at the center of coral reef management (IUCN, 2002). Additionally, COREMAP is designed to reinforce the national policies governing coral reef rehabilitation, management and conservation. Finally, the community-based development component of COREMAP is implemented through the promotion of sustainable use of coral reefs and their associated ecosystems,

1 - A new tool that allows users to visualize sources and uses of development aid, by country <http://www.aidflows.org/glossary.pdf>

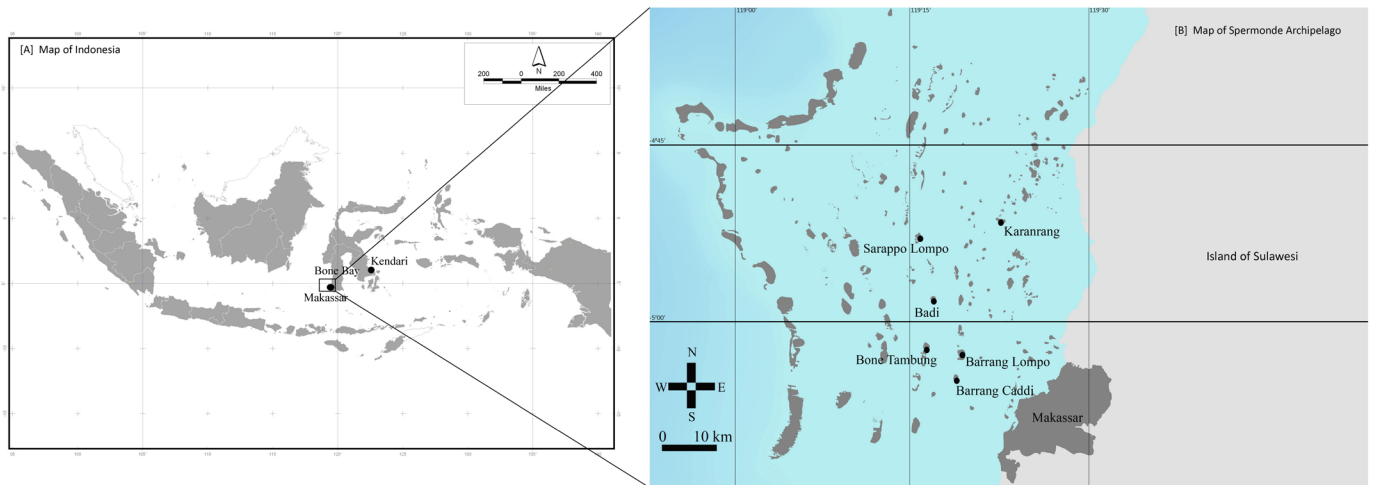


Figure 1. (A) Map of Indonesia and (B) Spermonde Archipelago
Figura 1. (A) Mapa da Indonésia e (B) Arquipélago de Spermonde

and through raising awareness about coral reef destruction created by overfishing and unsustainable fishing techniques. COREMAP aims to contribute to the Government of Indonesia’s objectives of sustainable utilization of the coastal ecosystem, decentralized natural resource management, and, raising income levels and improving living standards in the coastal zone and on small islands (particularly in small-scale fishing communities) through marine reserves. COREMAP is divided into three phases: COREMAP I (Initiation phase, 1998-2001), COREMAP II (Acceleration phase, 2001-2007), and COREMAP III (Institutionalization phase, 2007-2013).

Table 1. Source and amount of funding for COREMAP (Adapted from <http://www.coremap.lipi.go.id>)

Tabela 1. Montantes e fontes de financiamento do COREMAP (Adaptado de <http://www.coremap.lipi.go.id>)

Source of funding	Amount	Type
First phase		
World Bank (WB)	USD 6.9 million	Loan
Global Environment Facility (GEF)	USD 4.1 million	Grant
Asian Development Bank (ADB)	USD 7 million	Loan
Australian Agency for International Development (AusAID)	USD 6.3 million	Grant
Second phase		
WB	USD 56.2 million	Loan
GEF	USD 7.5 million	Grant
ADB	USD 8.27 million	Loan

As reported by IUCN (2002), COREMAP I has had several successes in achieving its development and conservation objectives signified by strong awareness and commitment of coastal communities in promoting the practice of sustainable fisheries and protecting the living resources on which their livelihood depends. Decreasing of illegal fishing practices such as blast and cyanide fishing has also been identified. Community Based Management (CBM) was introduced into the program in four field sites, where communities were involved in selecting village motivators and creating committees to prepare coral reef management plans that create sanctuaries and no-take zones. However, the report highlights also the shortcomings in coral reef protection, despite the strong community support, due to the lack of stronger legal and enforcement regime. COREMAP I has placed community at the center of coral reef management, thus shifting from the original design that emphasized coral reef management to a program which incorporate both environmental and developmental aspects as integral components (IUCN, 2002). COREMAP I has been rated satisfactory by the Independent Evaluation Group (World Bank, 2012a).

COREMAP II has achieved some targets which indicated its satisfactory performance in three different sectors: (1) management and empowerment, signified by the 70% level of awareness about the importance of coral reefs in all participating districts, (2) biophysical, signified by the 5% increase of live coral cover in program districts and (3) socio-economic and poverty, signified by the positive impact on welfare and economic status as perceived by at least 70% of fisheries/beneficiaries in coastal communities in program districts (World Bank, 2012a). The program’s direct target beneficiaries were 358 coastal communities in seven districts, including Pangkep, where Spermonde Archipelago is located. COREMAP II overall outcomes including its environmental objectives have been rated as moderately satisfactory (World Bank, 2012a).

Table 2. COREMAP achievements (Adapted from World Bank (2012a)).**Table 2.** COREMAP indicadores de implementação (Adaptado de World Bank (2012a)).

COREMAP Phases	Rate of achievements
COREMAP I	Satisfactory
COREMAP II	
Management and empowerment	Satisfactory
Biophysical	Moderately satisfactory
Socio-economic and poverty	Satisfactory

One of COREMAP's best known community-based initiatives is the community-based marine protected area (CB-MPA) program, which aims to facilitate an active community role in managing the protection of marine areas. The CB-MPA program is intended to address COREMAP's development objective of promoting the sustainable use of coral reefs at the village level through district-level marine area management. Specifically, the CB-MPA aims to decentralize political power and to place more attention on community-based approaches that can more effectively protect marine areas, and abate declining fish catches (Glaser *et al.* 2012). It is presumed that by protecting and rehabilitating coral reefs and their associated ecosystems the welfare of coastal communities will be enhanced. In order to achieve higher-level ecological objectives e.g. healthy reef ecosystem, COREMAP's CB-MPA program has declared one No Take Areas (NTA), a protected marine area as chosen by the community, per village in order to protect and rehabilitate the reef ecosystem of this particular village (Glaser *et al.*, 2010b).

3.1. Policy and implementation gaps

However even with an increase in designated NTAs, the practice of cyanide fishing is still continuing and is foraging to the new fishing grounds. Baitoningsih (2009) reported that in five villages where COREMAP was being implemented, 53% of respondents were not aware that there were protected areas in nearby water. It is also reported that most of the markers for the NTA, which were installed in 2007, were either gone or had sunk by 2009 (Baitoningsih, 2009). The island of Barrang Caddi provides several illustrations that not all of the CB-MPA goals were reached, creating conflict and disappointment. For example, one of the interviewees stated: "*CB-MPA is a good idea, for it provides space for fish nests; however, fishermen keep on going to that area (the no take areas) when the person seen as influential was absent. Even a patron practiced blast-fishing there, and when the influential person returned, he hit the patron*" (Interview #4, April 29, 2010).

The opinion on the CB-MPA illustrates that it is perceived as good but it is not an effective program. Another interviewee

expressed his disappointment about COREMAP's CB-MPA, as one of COREMAP's outreach people allegedly promised to bring grouper juveniles from Australia to be put into the fish nests in the MPA, but this was never accomplished.

COREMAP's community based and collaborative management programs is also perceived as a program which only benefit the 'elites' who are not the residents of the islands and not directly affected by the program (Glaser *et al.* 2012). Thus, the majority of those who knew about the NTAs of the MPA considered them to be a public authority program, a program established by the government and seen as exclusively benefiting only a section of the village population (Glaser *et al.*, 2010b). Accessing community-based revolving funds, which was intended to support households venturing into alternative livelihoods, was obtainable only through private contact with members of the coral reef resource management organization (LPSTK / Lembaga Pengelolaan Sumberdaya Terumbu Karang) or the village level microfinance organization (LKM / Lembaga Keuangan Mikro). Local public announcements about loan availability were not made in the villages where we conducted our interviews. Accessing resources and participating in decision making were not features that were open to the majority of villagers.

Another example, one interviewee in Karanrang Island said that collateral/material wealth, as well as a connection to COREMAP, was unofficially required in order to obtain loans. A fisherman in Karanrang Island provided the following insight: "*The money from COREMAP is just for the family close to COREMAP but not for others. It is also just for people who have money already*" (Interview #6, April 26, 2010).

The opinion on the distribution of COREMAP's loan illustrates the asymmetrical access to COREMAP's program which is dominated by relatively close relationship between influential community members and the COREMAP officials. Because of these COREMAP's inconsistencies of being inclusive of the entire community, COREMAP's CB-MPA organizational structures are viewed as being exclusive by the island communities (Glaser *et al.* 2012). These findings illuminate how island communities perceived COREMAP program resources as benefiting an influential minority, particularly the patron close to the people within COREMAP's organizational structures.

There is a need to reconsider the way in which local communities are involved in projects like COREMAP. Despite the suggestions of scholars from various disciplines on the need for more community participation in conservation processes (Pomeroy, 1995; Agrawal and Gibson, 1999; Agrawal and Gibson, 2001), there has been some concern regarding the shortcomings of the rhetoric and promises of community-based natural resources management (Leach *et al.*, 1997; Kellert *et al.*, 2000). The following part of this paper examines the LRFF commoditization through networks of actors at various scales. It might provide important insights in understanding the local socio-economic and socio-political dynamics which might be important for the improvement of community participation in conservation processes.

3.2. LRFF Trade as a commodity network

Fougères (2009) argued that live fish constitute a new and unique type of tropical marine commodity because it hinges on the fish's biophysical forms and their corresponding need to be constantly immersed in clean, cool, oxygen-rich seawater to survive. The commoditization in reef fishery relies on the fetishization of the LRFF in Hong Kong and China where consumers sought particular LRFF for the fine quality of their flesh. On the commoditization of natural resources, Nevins and Peluso (2009) argued that "Since the rise of capitalism, commodities have been integral to the making of global and regional economies and everyday life, the social relationships and therefore the politics of production processes are often obscured by a focus on, or fetishization of, the end product – the commodity as a thing – and its profit-making capacities and exchange value" (p. 2).

Fish are caught and traded through a commodity network (hereafter referred to as LRFF commoditization network). This network involves various actors located on the Archipelago who oversee the transport of the LRFF catch to the markets in Hong Kong (see Table 3) (Radjawali, 2011). This study identified three different types of networks constituting LRFF commoditization network: fishing networks, trading networks, and prosecution insurance networks (see Figure 2) (Radjawali, 2011). Understanding these networks provides insights into the commoditization of fish from when the fish are caught to when they reach the market. Specifically, fishing networks are primarily concerned with the actual catching of the fish from the sea; trading networks are primarily concerned with the transportation and categorization of the fish; and prosecution insurance networks are primarily concerned with protecting the LRFF trade from any legal prosecution since the continued use of illegal cyanide places the entire commodity chain at risk of legal prosecutions.

At the center of all these networks is the LRFF, there are at least eight reef fish species from the Spermonde Archipelago that are traded in the Hong Kong markets namely: (1) Highfinned grouper (*Cromileptes altivelis*), (2) Coral trout (*Plectropomus leopardus*), (3) Polkadot cod (*Plectropomus areolatus*), (4) Violet coral trout (*Plectropomus pessuliferus*), (5) Red flushed cod (*Aethaloperca logaa*), (6) Tiger grouper (*Epinephelus fuscoguttatus*), and (7) Spotted coral trout (*Plectropomus maculatus*) and (8) Napoleon wrasse (*Cheilinus undulatus*). Napoleon wrasse is listed as endangered on the IUCN Redlist (www.iucnredlist.org). Catching the Napoleon wrasse is therefore banned. The only exceptions are for: (1) research, knowledge development, and aquaculture, and (2) traditional fishermen with non-destructive fishing gear who have obtained a letter from the Minister of Agriculture and the Director General of Fisheries. However, the high economic value of this species has sustained its exploitation (including Napoleon wrasse) and through the continued use of destructive fishing practices, has placed more stress on the ecosystem.

3.2.1. Fishing network

The fishing network in LRFF fishing and trade consists of two types of actors: the *punggawa laut* (hereafter referred to

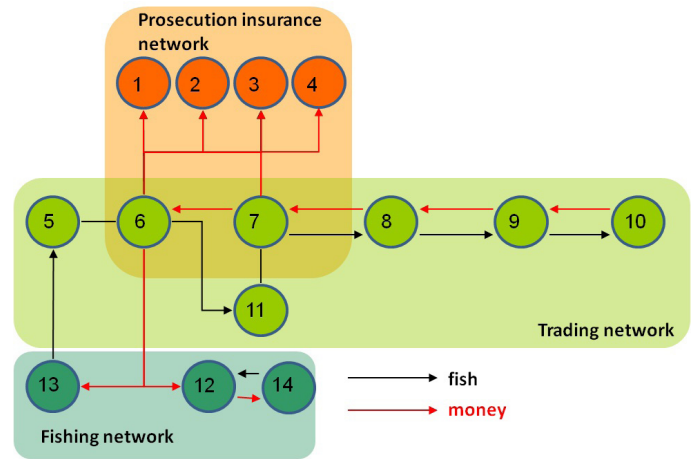


Figure 2. Live reef food fish commoditization networks comprise of fishing network, trading network and prosecution insurance network. Black arrows signify the flows of fish and red arrows signify the flows of money. (See Table 3 for detailed information on the numbers).

Figura 2. Redes mercantilização dos recursos pesqueiros. Setas pretas significam os fluxos de pesca e setas vermelhas significam os fluxos monetários.

as boat captain) and the fishermen. Both are locally known as *paboya* (the ones who catch the fish, hereafter referred to as catcher) and both have the knowledge on how to catch the fish using different gears and where good fishing waters are located. Reef fishing requires large investments in fishing gear, boats, and other supporting materials that are usually beyond the limits of any fisherman's financial capability, including the boat captain and fishermen. Thus to be able to fish, fishermen are dependent upon loan and debt of their patron.

This loan and debt tied to the interplay between seasonal dynamics and the limited resources of LRFF fishermen. LRFF fishing in the Spermonde Archipelago is highly dependent on the monsoon seasons, making it a rather tenuous livelihood considering the calm monsoon season lasts only 4 to 6 months. During the *musim barat* (west season, hereafter referred to as rough season) from October to March of each year, fishermen cannot go out to fish because the sea is too dangerous. Catchers with limited capital are dependent on their patron for loans to support their daily needs. During the *musim timur* (east season, hereafter referred to as calm season) from April to September, the fishermen are able to fish; however, due to the debt they accumulated during the west season, fishermen are left with no choice but to sell their fish to their patron at a price lower than market price. While patrons are dependent on the labor and knowledge of their catchers to supply fish for the market, catchers are dependent on patron for boats, fishing gear, and other supporting materials for their livelihood. This kind of mutual relationship constitutes the fishing networks that enable the LRFF fishing and trade industry to persist.

Another example of the dependance embedded in patron-fishermen relationship is evident in the type of resources that patron provide for catchers. The patron provides boats and money for his catchers, as well as subsistence and security,

Table 3. Actors and their roles in LRFF fishing and trade.**Table 3.** Os actores envolvidos e os seus papéis nas redes de pesca e comércio.

No.	Agent	Role in LRFF fishing and trade
1	Water police	Water police are involved in a joint operation (<i>operasi gabungan</i>) with the Navy, to secure certain marine and coastal areas against destructive fishing practices and the export of banned species. They receive money from patron and boss to avoid the prosecution of fishermen using cyanide and/or exporting Napoleon wrasse.
2	Police	Police are mainly responsible for land security and any illegal activities that might take place. However, the boss' fishing pond in Makassar is located under the police's jurisdiction. Policemen receive money from patron and boss to avoid the prosecution of fishermen for using cyanide and/or exporting Napoleon wrasse.
3	Navy	The Navy is mainly responsible for securing the Indonesian territory from the foreign fleets, including foreign fishing ships. Navy is involved in a joint operation with the water police, in order to secure certain marine and coastal areas against destructive fishing practices and the export of banned species. Navy member receive money from patron and boss to avoid the prosecution of fishermen for using cyanide and/or exporting Napoleon wrasse.
4	Prosecutor	Prosecutes criminals who violate fishing and trade laws. However, prosecutor are often subject to bribery by the boss in court for cases involving the use of cyanide.
5	Workers of patron (locally known as <i>sawi</i>)	This individual size (and weigh) the fish received from the fishermen/catchers. They are important actors in determining which fish go into which size categories. They are subject to bribing by the catchers, fishermen or boat captain whose objective is to maximize their profit by loosening the pricing rules.
6	Patron	The patron provides their catchers with fishing gear and monetary support. They also ensure that fish in good condition receive a better price. Patron provide protection against the prosecution of fishermen caught using cyanide or catching banned Napoleon wrasse.
7	Boss	The boss provide patron with fishing gear and monetary support. They also ensure that fish in good condition receive a better price. Additionally, they provide protection against the prosecution of fishermen caught using cyanide or catching banned Napoleon wrasse.
8	Jakarta-based exporter	Ensures that fish are in good condition. Ensures that fish can be exported and transported to Hong Kong without any problem.
9	Hong Kong-based importer	Ensures that the fish are able to enter the Hong Kong markets and to be distributed to Hong Kong restaurants.
10	Hong Kong restaurant	Provides aquariums for displaying the fish and sells the fish to the end consumer.
11	Worker of boss (also called as <i>sawi</i>)	These individuals size, weigh, and categorize the fish received from the patron. They are subject to bribing by the patron whose objective is to maximize profits by loosening pricing rules.
12	Boat captain	These individuals lead the team of boat crews/fishermen/divers and choose the fishing location and gear,
13	Fisherman	These individuals catch the fish. Local island communities consider all fishermen who work for a patron to be a catcher.
14	Fisherman/diver/boat crew	These individuals catch the fish. Local island communities consider all the fishermen work for a patron to be a catcher.

especially during the west season. There are two types of boats used in reef fishery, both of which influence the amount of debt that catcher is likely to owe to his patron. The smaller boat is called *lepa-lepa*, which is operated by one fisherman and accomodates a limited catch. The larger boat is called *joloro*, which is operated by three to five crew members, allowing for a greater catch. Fishermen with *lepa-lepa*, are

often indebted for the whole time between 10 million and 20 million Indonesian Rupiah / IDR (USD 1,000–2,000) to their patron, while catchers with the larger boats are indebted, at minimum, IDR 30 million (USD 3,000).

Fishermen with small boat can only fish using a hand-line, while catchers with the larger *joloro* can fish using the *bubu*, a baited fish trap made from bamboo. Catchers who

fish with the *joloro* boat can also fish with cyanide to stun the fish. Both *bubu* and cyanide require diving, with air compressors. The large size of the *joloro* allows the fishermen to carry a compressor, which allows them to dive deeper and longer, especially to catch the fish with the highest economic value in the market, such as the High-finned grouper (*Cromileptes altivelis*). *Bubu* gives fishermen a better catch than the hand-line, but cyanide gives fishermen an even better catch. Fishermen with a *lepa-lepa* can only get one or two fish after three or five days of fishing, while the catchers with *joloro* might get up to 15 fish after three or five days of fishing with *bubu*. This increases even more to about 20 fish if they use cyanide (see table 4).

Fishing networks are solidified through prolonged periods of interaction and dependence between patron and catchers in order to obtain fish to fulfill the market demand. For example, during rough season, some patrons and their catchers search for other fishing grounds, such as the reef areas of Kendari at Southeast Sulawesi or at Bone Bay in South Sulawesi (Figure 1, A). This practice of searching for new fishing grounds is known locally as *sawakung*. It means that the patron must invest a large amount of money (between IDR 40 million and 100 million, or USD 4,000 – 10,000) to send their fleets, usually a large carrier boat with up to 30 *lepa-lepa* to new fishing grounds. This practice lasts for several months, usually starting in October or November and extending until February or March. During this time, the patron is responsible for all of his catchers' needs, including food, cigarettes, petrol, and cash for the catchers' family (between IDR 1 million and 2 million, or USD 100 – 200), who have been left on the islands in the Spermonde Archipelago. One of the interviewed patrons describes this process clearly: “*I bring my fleet for sawakung to the far away fishing grounds like the area of Kendari. I give them limited money and petrol so that they can't get home to Spermonde easily, and they don't have any choice other than fishing. By doing sawakung in the further fishing ground, I can get more fish*” (Interview #1 in Sarappo Lompo Island, May 25, 2010).

3.2.2. Trading network

Trading networks in LRFF fisheries play an important role in transporting and grouping fish into different categories based on species and weight, a process which is determined by the pricing scheme. Fishers often do not have good market information because the supply-chain from catching to consumption is long and often involves the fish changing ownership along the chain. A Makassar-based Hong Kong Chinese company first caught LRFF with cyanide in the area's water in 1989, followed by a second company in 1990s and a third in 1992. Foreign Chinese, not Indonesian Chinese, captains and crews piloted and operated these companies' large wooden boats each outfitted with six or seven additional speedboats used to catch fish and bring them back to the main boat (Fougères, 2009). Access to the Hong Kong market was established through the connection between Foreign Chinese and Indonesian Chinese. It is identified that there is only one boss (Makassar-based middleman) who is not an Indonesian Chinese and managed to established his own networks to the Hong Kong market.

Trading networks are comprised of various actors who interact dynamically within an international context. These networks include four key agents: (1) patron, who are based on the islands and are responsible for financing their catchers to catch the fish and delivering fish to their boss, (2) boss, who are based in the city of Makassar and are responsible for financing LRFF fishing through their patrons and delivering fish to the exporters, (3) exporter, who are based in Jakarta and are responsible for exporting fish to the Hong-Kong based importers. Trading network in LRFF fishing and trade facilitates the fish pricing schemes (locally known as sizing rules).

Weight-based pricing schemes is broken down into the following categories: : (1) 'baby' (<0.6 kilogram) (some patron set the weight at less than 0.3 kilogram), (2) 'super' (0.6 to 1.2 kilograms), and (3) 'ekoran' (which means 'individual' in English) or 'up' (>1.2 kilograms) (see table 5). Fish pricing schemes can complicate an understanding

Table 4. Boat types, fishing gears and number of fish caught.

Table 4. Tipologia das embarcações, artes de pesca, e efectivos pescados (esforço de pesca).

Type of boat	<i>Joloro</i>	<i>Lepa-lepa</i>
Number of crews	1 captain with 2-5 crews	1 fisherman
Fishing gears used	<i>Bubu</i> and cyanide [equipped with air compressor and hookah for diving]	handline
Fish Caught	15 to 20 fish	1 or 2 fish
Days of operation	3 to 5 days	1 day
Debt in IDR (whole time)	Minimum 30 million (USD 3,000)	10 million – 20 million (USD 10,000-20,000)

of trading networks as these schemes are applied differently by different patron at different islands and by different boss at Makassar. The variation in pricing schemes is one of the primary reasons that many patron change their boss, as they are looking for a boss who is not only generous in providing social security and support, but also in providing a higher possible income through flexible sizing rules and pricing schemes. Dynamic supply-chain networks characterized by the changing network structure as a result of pricing schemes play important roles in building up and sustain the LRFF industry in Spermonde Archipelago.

Pricing schemes within the Spermonde Archipelago vary across the different islands and across different patron, depending on each patron's willingness to pay. Price differences influence the fishermen's preferences to establish a network with a patron, and they also determine the patron's preferences to establish a network with a boss. Fishermen and patron prefer to establish networks that give them an opportunity to bargain for more income. As one patron interviewed articulates: "*I like [a] bos who is generous in their sizing-rules. If I have fish which weigh a little less or a little more, it can be considered as super*" (Interview#1 in 'Sarappo Lompo' Island, May 25, 2010)

A boss who is generous in their sizing-rules gives the patron the opportunity to have a higher income. Table 5 shows what was paid by the patron to the catchers on a scale determined by weight. Fish in the 'super' category are priced higher and it is based on weight; whereas fish in the 'ekoran' or 'up' category are priced lower and it is based on the individual fish. It is identified that patron has their preferential catchers and boss have their preferential patron, presumably based on the number of catch that catcher or patron can deliver. Being a preferential catcher or patron will increase the opportunity to earn more money from preferentially applied sizing-rules of fish or more loan. One patron in Sarappo Lompo island said: "*My boss has his preferential patron, and I am not the preferential one. The preferential one deliver more fish and more continuously. It is*

also easier for him to lend more money from boss" (Interview #1 in Sarappo Lompo Island, May 25, 2010).

The boss is connected to his patron on the basis of trust and security given. He gives a loan to each of his patron, ranging from IDR 100 million up to 500 million (USD 10,000 – 50,000) based on patron's past achievements in selling fish to the bos. A patron interviewed said that there are (at least) three criteria for choosing to work for his bos, including power, generosity, and flexibility in sizing and pricing. This patron expressed his opinion about a bos who was considered to be good by many patrons in Spermonde Archipelago (however, the respondent himself does not work for this boss): "*This boss is a very good as he has so many connections and contacts in government and police and also so powerful. You don't have to be worried if you work for him. Police will think twice before arresting you*" (Interview #1 in "Sarappo Lompo" Island, May 25, 2010).

This patron believes that a good boss is one with power and connections to various actors to keep the business running despite any illegal practices. In addition, a good boss is one who is generous in his support of his patron through money, materials, and other resources. This preference to the good boss characterize the dynamic of LRFF supply-chain networks in Spermonde Archipelago, which might be the important insights for any management interventions intended to be made by development and conservation projects like COREMAP.

3.2.3. Prosecution insurance network

Sustaining the LRFF trade includes not only transporting and grouping the fish through supply-chain networks, it requires the establishment of prosecution insurance networks to protect the cyanide fishing practice to fulfill high market demand. The Indonesian Fisheries Law No. 31/2004 prohibits the use of any chemical (including bombs) and biological method or gear that threatens the ecosystem. Violators are subjected to punishment for up to six years in prison, or payment of IDR 1.2 billion (USD 120,000). At

Table 5. LRFF Sizing-rules and Price scheme of patron and boss.

Tabela 5. Tamanhos/ Pesos e Esquema de Preços praticados.

Weight category	Price paid by patron in Indonesian Rupiah (IDR) and (USD)	Price paid by boss in Indonesian Rupiah (IDR) and (USD)
Coral trout (<i>Plectropomus leopardus</i>)		
<i>Baby</i>	100,000 (USD 10)	150,000 (USD 15)
<i>Super</i>	400,000 (USD 40)	450,000 (USD 45)
<i>Up</i>	285,000 (USD 28.5)	335,000 (USD 33.5)
Highfinned grouper (<i>Cromileptes altivelis</i>)		
<i>Baby</i>	175,000 (USD 17.5)	225,000 (USD 22.5)
<i>Super</i>	400,000 (USD 40)	600,000 (USD 60)
Napoleon Wrasse (<i>Cheilinus undulatus</i>)	275,000 (USD 25.7)	325,000 (USD 32.5)

the regional level, the Pangkep Regency District Regulation No. 10 prohibits the collection and destruction of coral reefs in the area of Pangkep Regency in South Sulawesi including Spermonde Archipelago. Punishment may include up to six months in prison or payment of IDR 5 million (USD 500).

The lucrativeness of LRFF trade have particularly benefited the middlemen such as the patron, the boss, the exporters as well as fish importers in Hong Kong. However, the economic appeal of LRFF fishing and trade does not come without risks. According to Fougères (2009), LRFF fishing and trade involves greater technological complexity and economic risk than other exported marine commodities like sea cucumbers. For the fishermen, targeted fish are hard to catch as they live and hide in the coral reef at various depths. Also, fish need to be delivered as fast as possible to prevent mortality losses. In response to challenges like these, boss and patrons provide fishermen with air compressors that permit fishermen to dive longer and deeper, which increase their opportunity to catch more fish. This arrangement has encouraged fishermen to catch a large amount of fish in a short amount of time, which allow them to repay their debt to the patron more quickly and to earn more money.

Thus, the use of cyanide is prominent in LRFF fishing, as the catch rate using cyanide is much higher than the catch rate using more environmentally friendly fishing methods like *bubu* or hand-lines which also believed to increase the potential of lowering the fish price as the fish caught will probably have more wounds. Consequently, it has encouraged over-exploitation of LRFF. Removing the largest grouper fish through fishing could rapidly skew the sex-ratio of the stock (Coleman *et al.*, 1996; Morris *et al.*, 2000). Skewing the sex-ratio, may then lead to significant detrimental effects on the spawning potential and reproductive success of the population. In addition, removal of largest individuals leads to a juvenilization of stocks, which might also lead to changes in reproductive potential and success, as identified in the stocks of Anchovy Kilka (*Clupeonella engrauliformis*) in Caspian Sea (Karimzadeh *et al.*, 2010).

Understanding the logics behind the use of cyanide in LRFF fishing is important because it enhances our understanding of prosecution networks supporting the LRFF industry. The use of cyanide, for example, depends on the boss' willingness and ability to deal with prosecution through bribing. In many cases, boss who have established networks with various authorities, mainly with the police, navy and sometimes with officials from KKP (*Kementrian Kelautan dan Perikanan* / Ministry of Marine and Fisheries), are the ones who work with fishermen who use cyanide, confirming similar case in Maluku, Indonesia as reported by Adhuri (1998). These networks were created to protect the patrons who use cyanide from prosecution. Two interviews with the right-hand men of two different bosses in Makassar alluded to this practice by stating: "We give the commander of the police between IDR 1 million and IDR 2 million [between USD 100 and USD 200] per month and give IDR 50,000 [approximately USD 5] to each officer who comes to our place. There are usually two or three officers who come to collect money" (Interview #3 and #4 in Makassar, May 10 and May 18-21, 2010).

The interviewees also confirmed that they give money (see table 6) to the navy commandant and each navy member who regularly visit the pond: "We give the navy commander between IDR 1 million and IDR 2 million per month and IDR 50,000 for each officer who visits our fish pond" (Interview # 3 and #4 in Makassar, May 10 and May 18-21, 2010).

Table 6. Prosecution insurance expenses (Source: Radjawali, 2011).
Tabela 6. Preçário de Seguros praticado (Fonte: Radjawali, 2011).

Prosecution Insurance Body	Amount paid by "boss"
Water Police	IDR 50,000 - 100,000 (USD 5 -10) per person per visit.
Commandant of Water Police	IDR 1,000,000 – 2,000,000 (USD 100 – 200) per month.
Navy	IDR 50,000 (USD 5) per person per visit.
Commandant of Navy	IDR 1 million – 2 million (USD 100 – 200) per month.

Berkes (2002) argued that virtually all resource management systems have some external linkages and drivers at different scales, he points out that "Failure to recognize these linkages is a central reason for some unsuccessful interventions in resource systems and the persistence of resource degradation may be, in part, related to 'cross-scale institutional pathologies". As Berkes (2002) pointed out, "It is useful to start with the assumption that a given resource management system is multi-scale and that it should be managed at different scales simultaneously" (p. 317). This study demonstrates that an understanding of actors' relations in LRFF commoditization is important to affecting COREMAP programs like CB-MPA. Understanding how these relations are linked to the global market of LRFF provides insight for development and conservation projects like COREMAP in terms of incorporating existing local networks into their strategies and policies. Moreover, this study also points to the necessity that COREMAP pay attention to law enforcement and conservation in community-based projects. As this paper demonstrated, the existing prosecution insurance networks are embedded in LRFF fishing and trade networks, which on some level sustain the practice of cyanide fishing. International development goals need to pay more attention to the issue of prosecution insurance in order to avoid the shortcomings of their objectives.

This paper has demonstrated that the inability to address the existing LRFF networks hinders the achievement of COREMAP's development and conservation goals. This paper addresses uncertainties as argued by Brugnach *et al.* (2008), which emerge as a result of incomplete knowledge about the social system, in this case: the ignorance of existing

networks in LRFF fishing and trade. This conclusion supports the arguments made by Cinner *et al.* (2009b) “sustaining coral reef fisheries requires the integrated social-ecological systems approach which better understands and incorporates the socioeconomic factors that shape the ways that societies interact with reefs”.

4. CONCLUSIONS

Informed by ethnographic and interdisciplinary research in the Spermonde Archipelago, this paper has indicated that there have been shortcomings in COREMAP's objectives, particularly due to a lack of focus on the existing networks in LRFF fishing and trade and an inability to incorporate them in COREMAP's strategies and policies presumably due to the technical and more narrowly defined project frameworks. The inability to address the commoditization process of fish through the LRFF fishing and trade networks, the inability to address the establishment of new COREMAP organizational structures that do not comply with LRFF trade networks, and the inability to address and target the prosecution insurance networks have all hindered the achievement of COREMAP's development and conservation objectives. This study has shown the importance of understanding the “local” logics of LRFF fishing and LRFF ‘commoditization’ through various networks for development and conservation projects like COREMAP. Specifically, this research points out the need to provide solutions that address and target the complex local networks, while also considering how they are influenced by and influencing global trade networks. I argue that these insights are important for the ongoing debates in reef-conservation practices, particularly as they relate to the community-based management in conservation efforts and conservation efforts in general. It is important for development and conservation projects to understand how LRFF networks affect the reef conservation and how to incorporate this networks into the conservation management schemes. This conclusion supports the arguments made by Cinner and colleagues that Development interventions often result in disappointing outcomes without adequately consider the socioeconomic context in which fishers operate (Cinner *et al.*, 2009a).

Therefore, further research is needed to enhance our understanding of the behavior, motivations, and pressures placed on actors within the fishing, market, and prosecution insurance networks and how these behaviors, motivations, and pressures interact in the commoditization process of natural resources. This type of research is needed so that initiatives like COREMAP or the on-going Coral Triangle Initiative on Coral Reefs, Fisheries and Food Security (CTI-CFF), a multilateral partnership of six countries in Southeast Asia and Pacific addressing the urgent threats facing the coastal and marine resources of one of the most biologically diverse and ecologically rich regions on earth, can provide diverse solutions that are able to address the uncertainties of multiple interests and avoid obstacles to achieving their development and conservation objectives.

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