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Following the fish inland: understanding fish distribution networks for rural development and nutrition security

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Abstract

© 2019, International Society for Plant Pathology and Springer Nature B.V. In developing countries, small-scale fisheries are both a pivotal source of livelihood and essential for the nutritional intake of larger food insecure populations. Distribution networks that move fish from landing sites to coastal and inland consumers offer entry points to address livelihood enhancement and food security objectives of rural development initiatives. To be able to utilize fish distribution networks to address national development targets, a sound understanding of how local systems function and are organized is imperative. Here we present an in-depth examination of a domestic market chain in Timor-Leste that supplies small-pelagic fish to coastal and inland communities. We present the market chain's different commodity flows and its distributive reach, and show how social organization strongly influences people's access to fish, by determining availability and affordability. We suggest there is potential to advance Timor-Leste's food and nutrition security targets by engaging with local influential actors and existing social relations across fish distribution networks. We argue that in addition to developing improvements to fish distribution infrastructure, utilizing existing or locally familiar practices, organization and social capital offers opportunity for long term self-sufficiency. Livelihood and food security improvement initiatives involving natural resource-dependent communities are more likely to succeed if they incorporate rural development perspectives, which frame directly targeted interventions ('intentional' development) within broader structural contexts ('immanent' development).

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Following the fish inland: understanding fish distribution networks for rural development and food security

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ABSTRACT

In developing countries, small-scale fisheries are both a pivotal source of livelihood and essential for the nutritional intake of larger food insecure populations. Distribution networks that move fish from landing sites to coastal and inland consumers offer entry points to address livelihood enhancement and food security objectives of rural development initiatives. To be able to utilize fish distribution networks to address national development targets, a sound understanding of how local systems function and are organized is imperative. Here we present an in-depth examination of a domestic market chain in Timor-Leste that supplies small-pelagic fish to coastal and inland communities. We present the market chain's different commodity flows and its distributive reach and show how social organization strongly influences people's access to fish, by determining availability and affordability. We suggest there is potential to advance Timor-Leste's food security targets by engaging with local influential actors and existing social systems around fish distribution networks. We argue that in

addition to developing improvements to fish distribution infrastructure, utilizing existing or locally familiar practices, organization and social capital offers opportunity for long term self-sufficiency. Livelihood and food security improvement initiatives involving natural resource-dependent communities are more likely to succeed if they incorporate rural development perspectives, which frame directly targeted interventions ('intentional' development) within broader structural contexts ('immanent' development).

KEY WORDS

Coastal livelihoods; fish distribution networks; food security; rural development; small scale fisheries; Timor-Leste.

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1. INTRODUCTION

More people eat fish than catch fish. This simple asymmetry in production and consumption gives rise to fish distribution systems that connect fishers with consumers. In many developing countries, small-scale fisheries (SSF) help tackle malnourishment by providing nutritious sources of food (Béné et al. 2016; Fluet-Chouinard et al. 2018). Distribution systems reduce broader societal malnourishment by increasing access to nutritious fish among people living further from the source (Fabinyi et al. 2017). Improving fish availability through better infrastructure and technology is a primary objective for many rural development initiatives aimed at utilising and improving SSF (McClanahan et al. 2015). The development strategies guiding these initiatives, however, have tended to focus on making structural improvements to capture and distribution systems by, for example, modernizing gear (e.g. boats, fishing gear), storage, and processing infrastructure (Bailey and Jentoft 1990; Feidi 2005; Overå 2011). Generally, these costly sector development initiatives fall short in delivering anticipated outcomes for various reasons (Gillett 2010). Meanwhile the local trade often persists relatively autonomous to external modernisation attempts to improve access to fish, suggesting that these local trade systems are functioning based on other social, cultural and/or economic parameters. This warrants an in-depth examination of the often-overlooked social relations and networks that substantially constitute organization and practice within fish distribution systems in developing country contexts.

Foundational papers in the rural development and sustainable livelihoods literature (Harriss 1982; Chambers et al. 1989; Chambers and Conway 1992; Long 2001) recognize that interventions need to fit and function within broader, dynamic development contexts. Using a fish distribution network in western Timor-Leste as a case study, we argue that understanding the social networks and practices of fish distribution can usefully guide development strategies that involve diverse support agencies (government, non-state actors and multilateral organizations) that seek, under challenging time-constrained conditions, to support fish trade in pursuit of livelihood and food and nutrition security outcomes. We first describe the theoretical and geographic framing (section one), after which we outline our case study methodology (section two), and then present and discuss our results in terms of the functioning and organization of the network (section three). In the final sections, we reflect on the implications of the study for rural development support towards food security in Timor-Leste and beyond.

1.1 Rural development, food security and small-scale fisheries in Timor-Leste

Since its formal independence in 2002, Timor-Leste's development trajectory has been strongly characterized by its nation-state building objective (Palmer et al. 2006; McGregor 2007; Democratic Republic of Timor-Leste 2011; Aspinall et al. 2018). Its current population is estimated at 1.3 million

people, with an annual growth of around 2.4% (World Bank 2017). Population projections forecast a doubling by 2050, with an estimated 1.6-1.8 million people by 2030 (Democratic Republic of Timor-Leste 2014; Hosgelen and Saikia 2016) and 2.5-3 million people by 2050 (Molyneux et al. 2012). Timor-Leste is challenged with high levels of poverty and food insecurity, with 42% of its population living in poverty (World Bank 2016). This figure is an improvement from 2007 estimates (50%) and stands in line with the country's significant economic growth since independence. However, much of this growth is centred around urban areas, while the vast majority of Timor-Leste's population live in rural areas, which still lag behind urban development (UNDP 2011).

Food and nutrition security is also a major priority for Timor-Leste (NDFA 2013). With a global hunger score of 34.3 the country is ranked among the most food insecure countries in the world (von Grebmer et al. 2016); 60-70 percent of the Timor-Leste population is reported to be food insecure (Molyneux et al. 2012; Hosgelen and Saikia 2016). The latest national nutritional statistics show that among children younger than five 46% are stunted (General Directorate of Statistics et al. 2018). While there have been some improvements over the past decade, reflecting efforts of the Timor-Leste government and partner organisations, undernutrition remains too high and continues to be a priority development issue.

The National Food and Nutrition Security Policy (NFNSP), set the ambitious target that "By 2030 Timor-Leste will be free from hunger and malnutrition and Timorese people will enjoy healthy and productive lives" (Democratic Republic of Timor-Leste 2017: 13). The intention to develop fisheries as part of this strategy is reflected in the key target to increase annual per capita consumption of local fish from 6 kilograms to 10 kilograms by 2020 (Democratic Republic of Timor-Leste 2017). The potential to increase fish consumption through development of local fisheries (as opposed to imports) comes partly from the recognition that some fish stocks in Timor-Leste may be underutilised (Mills et al. 2013).

While actual figures vary, previous assessments concur that national fishing capacity along Timor-Leste's 700 km coastline is low (AMSAT International 2011b; Alonso Población 2013; Mills et al. 2013). An early post-independence survey, for example, suggested there were about 5500 fishers in Timor-Leste at the time (McWilliam 2002), while estimates based on a 2010 census of fishers recorded approximately 4700 registered sea fishers and 3000 registered boats (Alonso Población et al. 2012). The most recent 2015 national census suggest there are 3943 households that own at least one boat (Timor-Leste NSD 2015). The vast majority of fishers use small wooden outrigger canoes powered by paddle or motor (5-15 horsepower); gill nets and hand lines are the most widely used gears. Due to the comparably favourable conditions (and in part due to the more developed infrastructure) most fishing takes place along Timor-Leste's northern coast, within 2-4 nautical miles from the coast around nearshore reefs, river mouths, fish aggregation devices (FADs) and seamounts.

Fisheries and food security analyses report that the main constraint for consumption of fish in Timor-Leste is access, availability and affordability (Andrew et al. 2011; Andersen et al. 2013). The lack of infrastructure for transport, storage and post-harvest handling means 75% of fish is consumed fresh (Food and Agriculture Organization of the United Nations 2009). Timor-Leste's extreme topography means that access to fish by non-coastal households can be particularly difficult. Poor availability of fish is reflected in the per capita annual fish consumption in coastal areas (17.6 kilograms) being substantially higher than that of non-coastal areas (4 kilograms) (AMSAT International 2011a). Herein lies the challenge to reduce malnutrition and achieve the fish consumption target in the NFNSP: how can fish distribution to these remote areas be improved?

1.2 Fish-based market systems

Localised market systems often operate in arenas that are not state-regulated and can therefore develop alternate social and economic spaces wherein people function (Roxas and Azmat 2014). The loose employment of many people in trade networks means a variety of mutually dependent livelihoods converge and develop (Crona et al. 2010). Primary producers (e.g. fishers), transit market actors (e.g. middlemen and women), and final consumers all connect and interact through trade within spaces that are differently institutionally bounded than their other day-to-day bounded living spaces. People functioning in these market spaces thus do so by navigating different sets of accountabilities that may be part of the market and/or their other social spaces. The various relations connecting people across such spaces indicate considerable amounts of bonding, bridging and linking social capital (Grafton 2005). Some of these relations are born and exist from market transactions, like patron-client relations, while others are brought into market contexts from other spheres, like kinship. As a result, market systems can be seen to form important settings for maintenance and expansion of peoples' social as well as economic ties, and therefore provide important platforms for rural development intervention across spaces beyond a single community focus.

A growing body of literature argues for more nuanced understanding of the various contexts in which SSF function with or against market systems, and the multiple objectives by which actors involved operate (Wamukota et al. 2014; Kittinger et al. 2015; Béné et al. 2016; Steenbergen 2016). While there is growing awareness of the cumulative pressures that markets can put on stocks and people (Crona et al. 2016), in-depth social dynamics of local processes are poorly understood. Such fish-trade dynamics are critically important to consider in poverty and food security contexts because social factors mediate relationships between food stocks (i.e. availability) and consumption (i.e. access) (Fabinyi et al. 2017).

Market and chain analyses commonly focus on structural and utility-oriented aspects of trade, which emphasise directed material investments (Bailey and Jentoft 1990; Feidi 2005; V. Christensen 2010b;

Overå 2011; Kirby and Di'ak 2018). Such analyses are, moreover, often carried out with somewhat crude resolutions, focus on price mark-up and market mechanisms, commodity counting or are analysed from central market hubs. Consequently, the social workings of domestic market chains in places like Timor-Leste, and how they function through producers, traders and consumers in the context of widespread food insecurity, and poverty, remain understudied. An in-depth examination of the commodity flows in a market chain, and the various structural and agent-based influences working on these flows, provides an alternative perspective to the more common utility-oriented market analyses in the grey literature. This study details the complex social milieu that underpin resource flows from producers to consumers in Timor-Leste. We explore how the fishery development sector is challenged to make a positive difference to the management of SSF and trade for food security. Designing appropriate directed (short term) interventions that are in tune with broader development trends is vital for external support to make meaningful contributions to alleviating poverty and food insecurity (Morse and McNamara 2013).

2. METHODOLOGY

2.1 Study site: Bobonaro District and Beacou

We draw on a case study of a fish distribution network originating at the coast in the Bobonaro Municipality[1] in Timor-Leste. Bobonaro is located in the north-west of Timor-Leste. It has a north-facing coastline and shares a border with Indonesia to the west. It is made up of six Administrative Posts (or subdistricts) with its capital, Maliana, located centrally in the highlands approximately 60 kilometres from Beacou (Figure 1). The region has a population of just under 98,000 people, making it the fourth most populous district (Timor-Leste NSD 2015). With exception of its coastal communities and larger towns, many communities in the district are distributed extensively across small, hard-to-access, upland settlements where reliance on subsistence agriculture is high. As in many areas in Timor-Leste, rural households face annual hunger seasons (*tempu rai hamlaha*), which typically occur during pre-harvest periods, when food supplies from previous harvests run out, current crops are premature and seasonal conditions hinder wild harvest activities like fishing (da Costa et al. 2013). Challenged by access to nutritious food, rural households in Bobonaro struggle to compensate for hunger season shortages in meeting adequate nutritional intake, which in part is reflected in the country's second highest prevalence of childhood stunting with 53% (General Directorate of Statistics et al. 2018).

[1] Reference to Bobonaro within the context of this study refers to the Municipality (district), and not the similarly named Administrative Post (subdistrict) or Village (*suco*).

Along the Bobonaro coast mostly small pelagic fish, such as sardines, flying fish and scad mackerels, are caught and distributed through trade. The area is characterised by food insecurity, high poverty rates, poor infrastructure, and little government presence. These conditions provide the opportunity to examine active civil society actors and defined channels of commodity flow in the context of poor infrastructure. In defining the research scope, we recognise that at the time of research there were outward flows of fish from the district to, for example, the capital of Dili, as well as flows of fish into the district, including imports from Indonesia. Moreover, there were several other catch landing sites along the Bobonaro coast. Here we focus on fish from the landing site in Beacou village to extensively dispersed consumers within Bobonaro Municipality, because at the time of distribution network study this was the largest and most active.

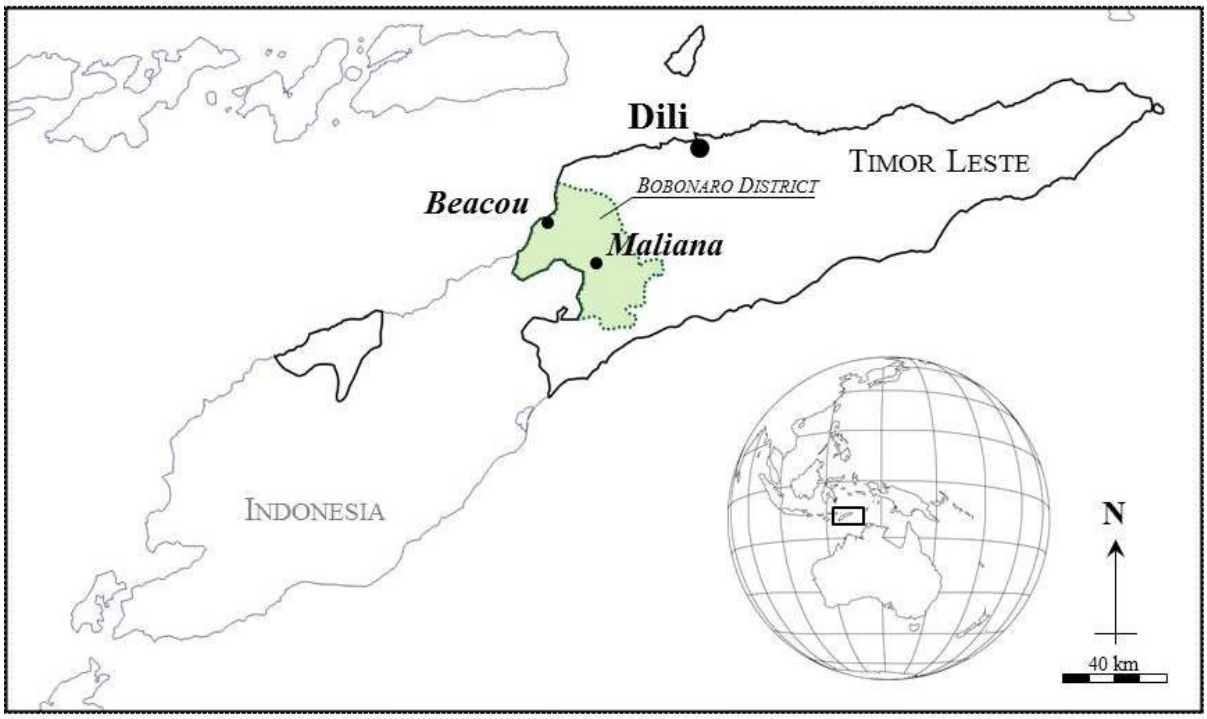

Figure 1: Map of Timor-Leste indicating the location of Bobonaro district, Beacou as the main catch landing site and the district capital of Maliana as the major inland distribution hub for the district.

Beacou is one of nine hamlets (*aldeia*) in the village (*suco*) of Aidabaleten in Atabae subdistrict. Timor-Leste is divided administratively into several tiers of government: national, municipal (composed of multiple administrative posts) and village, which are composed of several hamlets often distributed over large areas. The term 'community' here refers to physical settlements, that often correspond to the unit of hamlet. Beacou forms the case study's market chain supply site and is located three hours drive west from Dili, half an hour east from the Indonesian border (Batugade) and

an hour and half from Maliana (the district capital) (Figure 1). The combination of favourable boat access in Beacou, its location on the main road between Dili and the district capital of Maliana, and having received fishery capacity building support over the years, meant Beacou's production of fish into Bobonaro's fish market chain exceeded any other community along the district's coastline at the time of field research between 2014 and 2017 (see also Alonso Población et al. 2013).

The most recent national census (2015) counted close to 580 people living in about 100 'private households' in Beacou. Three main family lineages make up the social structure of the settlement, whereby strong narratives of origin place the 'founding lineage' socially above the two other lineages. This social institutional hierarchy has deep impact on local governance and leadership (Alonso-Población et al. 2018a; Alonso-Población et al. 2018b). One's claim to land tenure, for example, is guided by customary laws of precedence over land ownership and access *(rai na'in)*, and dictated by their affiliation to lineage (Alonso Población et al. 2013). State administrative structures have come to be embedded within this local social structure. This is evident from prominent lineage representation in administrative village leadership positions and with aspects of customary law being taken up into formal natural resource management regulations. For example, during the time of fieldwork, the head of the founding lineage also assumed the hamlet head (*xefe aldeia*) position, and, state-instituted fishing groups in the community to administer fisheries support had formed around existing kinship structures.

Livelihood portfolios of households in Beacou are mixed, like in many coastal settlements in Timor-Leste (see also Mills et al. 2017). Most households in Beacou indicated fishing to be a prime source of livelihood, next to agriculture, salt production and trade. Fishing practices in Beacou predominantly targeted a variety of small pelagic fish species according to their seasonal abundance, including scad (*Decapterus* spp.), garfish (*Hyporhamphis affinis*) mackerel (*Scomberomorus* spp.), flying fish (*Cypslurus* spp.), tuna (*Thunnus* spp.), sardine (*Sardinella* spp.), and needlefish (*Tylosurus spp, Ablennes hians*). The extreme ocean bathometry in Timor-Leste means many of the pelagic fish stocks can be caught relatively close to shore, often around FADs. Limited by capacity, most fishing took place within a 20 kilometre radius from Beacou, from the Loes River mouth to the north-east (targeted seasonally for sardines) to the Indonesian border to the west. Fishing and gleaning on shallow reefs and in mangroves were also practiced, particularly in seasons when rough seas inhibit fishing further out to sea. The beach in front of Beacou forms the main catch landing site and point of primary trade transaction between fishers and middlemen.

Since independence, Beacou has received various forms of fisheries support from state and non-state actors, including the deployment of FADs, periodic handouts of fishing gear, boats, and outboard motors, and development of village fisheries regulations. Notably, as part of a national initiative to improve the production, trade, management, and governance of small scale fisheries, in 2008 the National Directorate of Fisheries and Aquaculture (NDFA) constructed fisheries centres (*lota de*

pesca) across Timor-Leste, including one in Beacou (Lentisco et al. 2013). Beacou's fisheries centre was built adjacent to the beach landing site with NDFA's initial ambition for it function as a fisheries auction centre, however it was never made fully operational. Between 2009 and 2013 the Regional Fishers Livelihood Project (RFLP) sought to repurpose the centres by utilizing them to as rural nodes for fish catch data collection, information dissemination to fishers, ice distribution and cool storage, and capacity training (Lentisco et al. 2013). In Beacou, the revival efforts focused primarily on collecting fish landing data and training, as the lack of electricity and poor water quality inhibited ice production. Although results were positive during the life of the RLFP project, during the time of fieldwork from 2014 onwards the facility remained largely unused.

2.2 Data collection

Trade of fish in Bobonaro often occurs opportunistically, without state regulation and/or responsive to conditions. The vast majority of fish is traded fresh, although some drying takes place when large catches can not be sold; some fresh fish gets sold by local restaurants as grilled fish or '*ikan soboko*' (grilled in sago leaves). In highlighting commodity flows and transactions the research does not suggest trade occurs only along discreet channels. Instead, the research seeks to go as far as to offer insights into practices around trade and consumption of locally landed fish that are influenced by complex social structures and conditions. As such, data collection was framed around a grounded theory qualitative approach (Madison 2005) in order to examine social dynamics of actors and groups operating within (loosely organised) networks along the market chain. Secondary stages of research and enquiries into particular events or patterns were strongly guided by findings from the first stage of data collection.

Acknowledging that SSF and associated market chains are complex, diverse and dynamic (Jentoft and Chuenpagdee 2009), a suite of qualitative mixed methods were applied over two main phases of data collection. Research activities were conducted during seven field visits to Bobonaro district between 2014 and 2017. All fieldwork was carried out in partnership with a local research assistant from either the community (during phase 1) or the Maliana district fisheries office (during phase 2). Interviews were conducted Bahasa Indonesia, or in Tetun language, for the latter a research counterpart provided necessary translation services.

The initial phase of research fieldwork was strongly place-based and explored the social organization around SSF and trade at the catch landing site in Beacou. A rapid household survey across all available households in Beacou was carried out (n=90) to gather information on (seasonal) livelihood dependence and income, household assets, people's memberships to (local and/or externally facilitated) social institutions and the extent of involvement in fishing and fish trade. This process identified the main market actors in the community. Semi-structured interviews were then conducted

289 with fishers (n=22) and middlemen (n=8), randomly selected from respondents who identified
290 primarily as a fisher or middleman in the household survey. These interviews enquired about fishing
291 practices, benefit distribution, trade arrangements and the local institutional rules around fish
292 transactions. At the end of this first phase of data collection, focus group discussions (FGD),
293 including a participatory mapping exercise to summarize the main flows of trade, were conducted
294 separately with fishers and village middlemen, and with village leaders, to reflect on and verify
295 findings from interviews. FGDs guided by participatory mapping exercises, were also held with
296 fishers from neighbouring fishing communities along the Bobonaro district coast (Batugade, Palaka
297 and Sulilaran), to clarify their trading arrangements and contextualise findings from Beacou in the
298 broader district.

299 Subsequent fieldwork investigated the flow of traded fish through transit processes leading to final
300 consumption. This phase applied a mobile and adaptive data collection strategy that involved
301 'following the fish' and collecting data at different locations along the market chain. Applying
302 opportunistic and subsequent snowball sampling, semi-structured interviews were carried out with
303 middlemen (n=19) who were in transit and at central market hubs. These interviews enquired about
304 trading arrangements, barriers to trade, target species, pricing, networks of supply and consumer
305 bases. Semi-structured interviews were also conducted with consumer households in and around
306 Maliana town (n=21). As the major market hub[2] within the municipality, it became an important
307 location from which to collect data on final trade and distribution to consumers. Interviews were
308 guided by questions on average daily food consumption and composition, their sourcing and
309 consumption of fish, pricing of fish and barriers experienced in accessing fish. Sampling of
310 households was based on opportunistic sampling across three inland communities located 10 km
311 (n=9), 15 km (n=5) and 25 km (n=7) from Maliana central market.

312 During both research phases, unstructured data collection yielded often sensitive information, which
313 in some cases revealed trends or findings in need of further enquiry while in other cases verified
314 findings from, for example, interviews. The lead author's short intermittent residencies in Beacou, for
315 example, allowed for frequent informal conversations with three key informants (a middleman, the
316 elected hamlet head (*xefe aldeia*) and the village fisheries centre caretaker) and participant
317 observations during fishing trips and village meetings. Visits to fish markets similarly allowed for
318 observations and informal unstructured interviews with vendors and consumers.

319

[2] Other significant market sites in Bobonaro include Batugade, Balibo and Atabae vila. However, due to its status as Municipality capital, its central location and having the largest population in the Municipality, Maliana is the largest fish distribution point in Bobonaro (Timor-Leste NSD 2015).

3. RESULTS AND DISCUSSION

3.1 Roles in the fish distribution chain

Middlemen are locally referred to by various interchangeable terms. For the purposes of this study we distinguish between 'collectors' and 'traders', referring to the two broad distinctions that were observed. The former, generically called 'collectors' (*pengumpul*), were entrepreneurial, well-resourced and connected middlemen operating at the centre of a personal network. They typically had comparatively higher capacity for storage and transport at their disposal and coordinated trade with a series of mobile traders, often under some form of working agreement. These actors were seen to have significant agency and network capital through which commodity flows could be directed. The latter type, 'traders', operated as more individual, smaller-scale middlemen. These free operating middlemen were identified locally based on the type of transactions, thus including terms like 'trader' (as intermediary traders: *papalele, tengkulak*), 'buyers' (as traders buying fish from someone: *pembeli*) and/or 'sellers' (as traders selling fish to someone: *penjual*). Given the relatively short market chains operating from Beacou, middlemen often fulfilled all these trading functions.

3.2 Fish flows and spatial market catchment

We distinguish three main pathways for fish landed at Beacou (Figure 2): trade and gift-giving within Beacou village; trade through middlemen to coastal and inland communities in Bobonaro district, including substantial trade to the district capital Maliana; and trade through middlemen to urban Dili. We also make reference to small scale imports from Indonesia (predominantly unregulated) to both Maliana and Dili markets. In examining the spatial distribution of fish from Beacou in Figure 3, an indicative catchment of the market starts to suggest where fish is being consumed. The transactions, actors and spatial distribution involved in each pathway are further detailed below, acknowledging that the framing of these distinct paths is a conceptual construction, and that at times these paths are blurred by the messy, dynamic nature of local market systems.

The shortest and most immediate flow of fish from landings in Beacou fed into subsistence consumption needs of fisher household and inter-household trade and gift-giving practices (indicated by the black flow-lines in Figure 2). These short paths involved a relatively minor portion of the catch from landings (estimated at less than 5%) but, as outlined in the section below, these played important roles in maintaining the integrity of local social relations.

The majority of fish was traded out of Beacou and went through in-village middlemen (as indicated by the blue flow-lines in Figure 2). Commodity flows to Bobonaro District consumers occurred through three channels. Firstly, fish were sold directly to rural households in the coastal and immediate inland region around Beacou by the in-village collectors. This typically involved a younger

family member (*anak bua*) selling fish door-to-door by motorbike in these remote 'off-the-main-road' communities (and roadside district restaurants). Secondly, fish were sold by Beacou collectors to mobile traders on motorbikes from Maliana, who travelled every morning to Beacou and other coastal villages to buy fish, before returning by the early afternoon. Their fish was then sold to consumers on the daily afternoon Maliana fish market and by door-to-door sales in villages in and around the district capital. Thirdly, when large catches (between 200-400 kilograms) occurred, fish were directly sold in bulk to a collector in Maliana, whereby the transaction and transport arrangements were settled over the phone. From this point, the fish would enter the Maliana fish market or be distributed deeper inland by door-to door motorbike sales.

These district trade flows of fish from Beacou showed a wide spatial distribution (indicated in blue shading in Figure 3), for which the Beacou fisheries centre was not used. Beacou collectors and their mobile door-to-door sellers claimed a significant consumer catchment of rural villages to the east, particularly since Maliana-based mobile traders channelled most of the fish towards Maliana market in the west. Beacou mobile traders reported selling fish in villages as far as Liquica district and inland in Ermera district, even though the coastal areas to the east also have fisheries. Fish traded to Maliana mobile traders contributed to a consumer catchment throughout the western and inland part of the district.

The majority of Maliana traders interviewed noted that 90% of their collected catch was sold in and around Maliana, while about 10% would be sold through in-transit trade on their way back to Maliana. Such in-transit trade delivered fish to 'intermediate' communities located between the coast and Maliana, like Balibo. Some mobile traders occasionally made considerable detours on their way back to Maliana to reach more remote communities for door-to-door sales. Distribution of fish in Maliana centred on the daily afternoon fish market, while rural communities in and around Maliana were served by door-to-door motorbike sales. The latter trade was often coordinated from the Maliana fish market, after daily collections from the coast were sorted and prepared. In interviews with rural upland communities, consumers also noted to frequently visit Maliana to buy fish, particularly on weekly Saturday markets, intensifying trade at market sites.

Finally, fish were sent to the urban consumers of Dili, as indicated with yellow lines in Figures 2 and 3, mainly with catches that included large size fish and/or extremely large total volume (with examples of catches in excess of 400 kilograms). These passed through three main channels. Firstly, trade occurred between Beacou collectors and collectors in Dili, who coordinated a pick-up truck to drive along the coastal highway between Dili and Beacou (and occasionally the Indonesian border) on a daily basis to buy fish from all coastal villages to sell on Dili-based markets, supermarkets and/or restaurants. Secondly, in cases of large catch volumes, fish were sold through direct specially-arranged trades between Beacou and Dili collectors, whereby price and transport arrangements were inclusive of the deal. Lastly, fish was traded to Dili consumers through opportunistic roadside sales in

the village. Located on the main coastal link between Dili and the Indonesian border, roadside sales offered significant opportunity to sell at higher profit margins to Dili-bound travellers who have higher purchasing power. Such roadside sales are common in communities all along the coastal highway, with the Batugade border post, Beacou and Loes/Atabae vila being the most significant supply points. Fish distribution to Dili (indicated by yellow shading in Figure 3) indicated a more concentrated consumer catchment around the urban area of Dili, due to the more dense demand of the urban population. Dili-based collectors operating this trade noted that with higher selling prices in Dili, little offshoot trade took place in transit, so that all their fish was sold and consumed within Dili.

Unregulated fish imports from Indonesia (red flow-lines in Figure 2 and 3) fed into both Maliana and Dili distribution centres. In Maliana, small pelagic fish smuggled through the highland border were sold cheaply at the weekly Saturday market. This market drew in rural consumers from remote areas, facilitating distribution of fish further into the uplands (indicated by red shading in Figure 3). Fish also entered through the Batugade border post or by boat through coastal villages close to the border. These fed primarily into trade with Dili collectors operating on the Dili-border link, with final consumption by Dili households or restaurants. Much of this trade involved fish that failed to sell on local Indonesian markets and were consequently several days old. There was no indication of a trade flow from Bobonaro into Indonesia, largely because of the surplus of fish in Indonesia from the more intensive fisheries there. While fish trade to Maliana was more consistent (due to the weekly market), trade frequency into Dili was determined by opportunity (i.e. when catches were large) suggesting more coordinated facilitation efforts were required to respond when such opportunity occurred.

A central challenge across all commodity flows was avoiding spoilage of fish. In the absence of systematic cold chain infrastructure, majority of traders minimised their transit time, thus affecting their reach. However, larger collectors in Beacou and Maliana overcame this by investing in freezers to produce ice; which they sold to mobile traders or used for their own fish-transport operations. Weak control on fish quality in transit or at markets meant some traders resorted to unhygienic preservation methods to mask signs of fish decay or sold bad quality fish at lower prices. The latter practices not only compromised the quality of fish eaten by consumers, but also posed a serious health hazard.

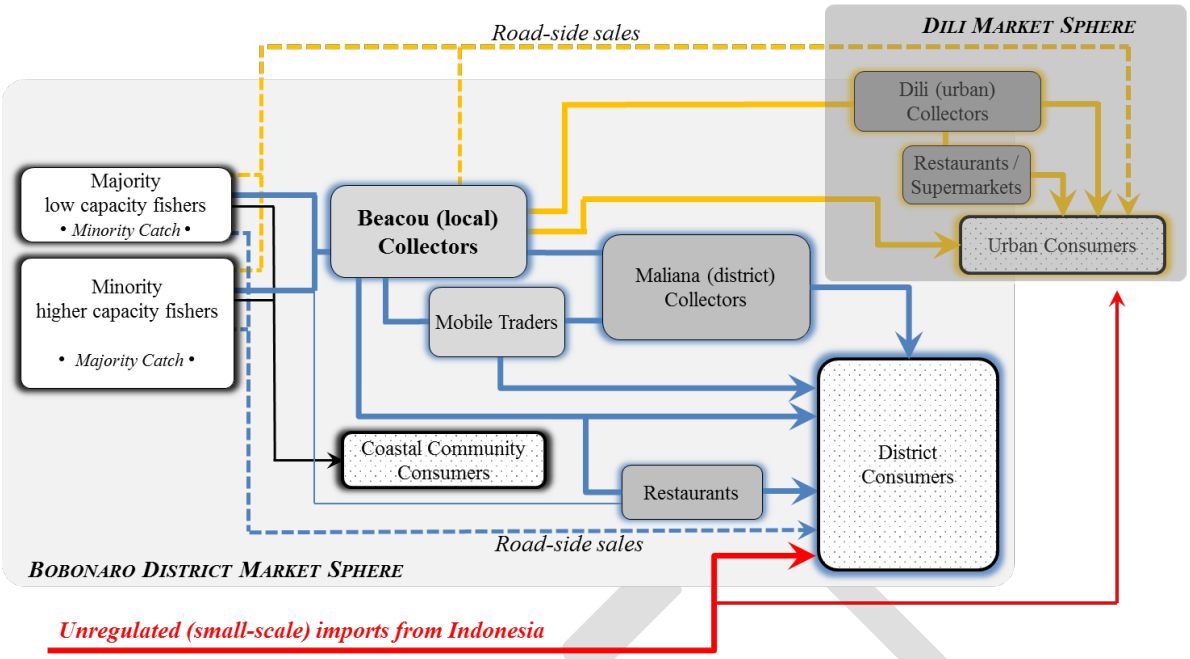

Figure 2: Schematic indicating three fish commodity paths sourcing from Beacou landings: (i) in-village transactions [*black*], (ii) transactions serving consumers in the district [*blue*], and (iii) transactions serving Dili consumers [*yellow*]). Unregulated trade from Indonesia [*red*] forms a fourth commodity path. White text boxes represent fish production actors, grey text boxes represent transit actors and patterned boxes represent consumer actors. Dotted lines represent opportunistic road side sales, while solid lines refer to trade through middlemen.

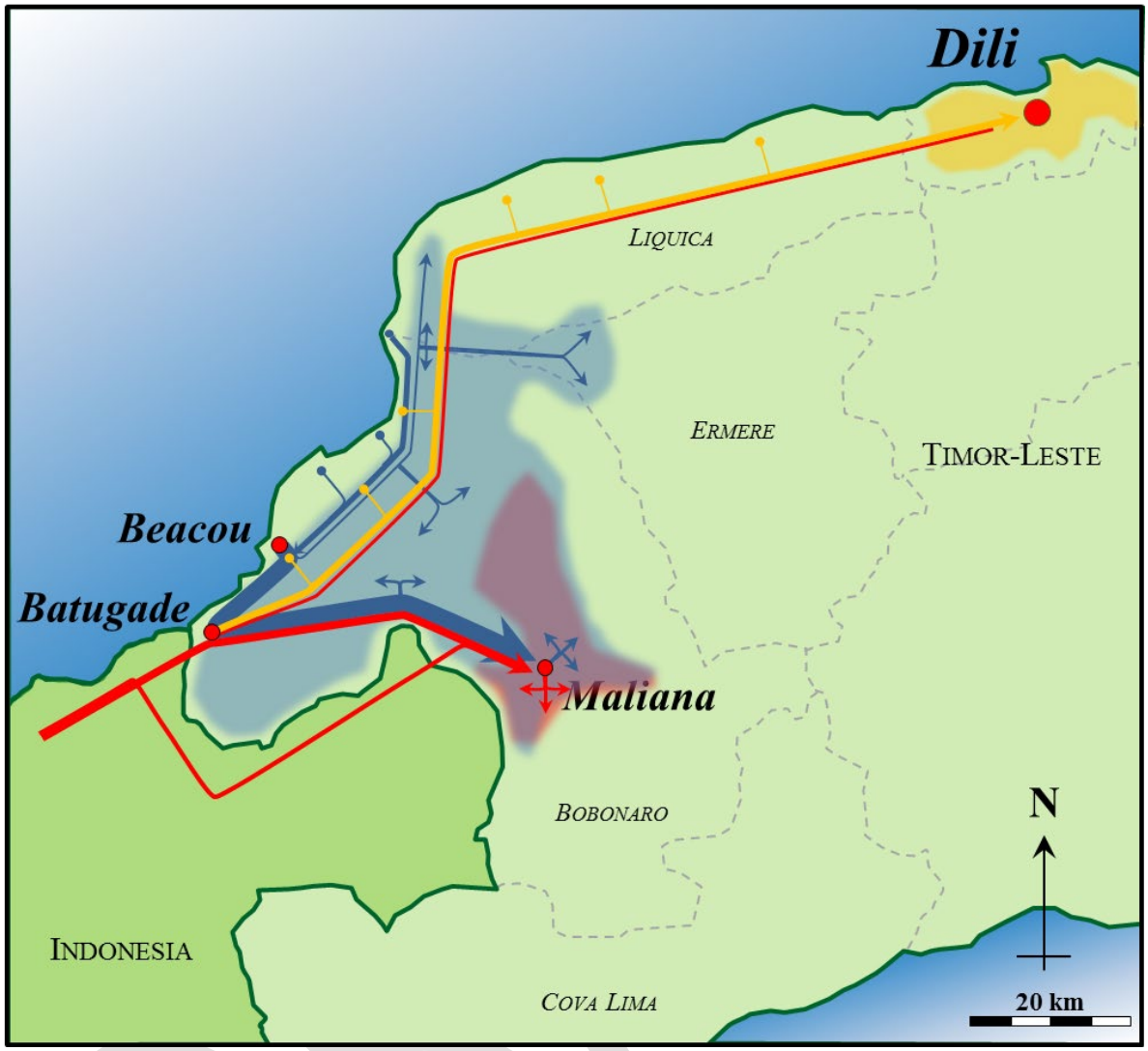

Figure 3: Schematic representation of (i) flow of fish sourced from Beacou [blue line] and distributed within Bobonaro Municipality [blue shading]; (ii) flow of fish sourced from Beacou and landing sites in other communities along the north coast [yellow line] and distributed within Dili [yellow shading]; and (iii) unregulated cross-border fish trade from Indonesia [red line] and distribution within Bobonaro Municipality [red shading]. Thickness of commodity flow represents perceived relative importance (frequency, consistency and proportion of trade) to respondents situated along the Beacou to Maliana commodity pathway. Note that distribution of fish within other municipalities (e.g. Liquica) and distribution of Indonesian-sourced fish within Dili was not explored and is not shown.

3.3 Physical factors influencing fish trade

The distribution dynamics of fish trade strongly reflected accessibility to consumers and transit affordability, as well as seasonal variation in fish availability. These variations affected the different market actors in various ways and to differing extents. The reach of road networks was overwhelmingly regarded as the main factor determining the spatial distribution of fish trade; all

traders noted that the coastal highway formed the fundamental vein along which they sourced and sold fish. Beacou collectors also noted that trade to Dili had increased in recent years largely due to road improvements in 2014-2015. Physical features were also influential barriers to trade. Beacou village is nestled at the base of a steep headland to the west, which the main road skirts around by veering off the coast to wind up and down steep gradients. This headland marks a soft trade boundary for Beacou mobile traders and they preferred to orient their door-to door trade eastwards partially to avoid having to surmount the headland. Similarly, Beacou collectors frequently bought fish from eastern neighbouring fishing villages, but only considered buying fish from western fishing villages (i.e. on the other side of the headland) if a large volume of fish had been caught. Dili traders were also noted to often turn back to Dili in Beacou instead of continuing to Batugade border post if there was no need for it (i.e. enough collected catch). In that context most Beacou collectors spoke of the headland as a fortunate barrier for them in concentrating fish-trade interest to Beacou. Fish trade to the south of Maliana was similarly restricted by poor road access over a central ridge of mountains forms another soft market boundary.

Seasonal variation in fish catch determined the species and amount of fish that was traded, which in turn influenced trader's choice of fish distribution pathway. During rainy season between the months of January to March, river runoff attracts schooling sardines and this drew fishers to near shore river mouths. Between May to October, when prevailing easterlies blow, flying fish were targeted. In the intervening months, other pelagics were targeted by net fishing or line fishing at FADs. Seasonal catches of species translated to trade intensification in the district, with significant spill-over into the market paths to Dili. As such, trade to Dili increased in peak seasons of flying-fish, sardines and/or tuna when either large fish or large volume catches warranted trade to Dili collectors. Conversely, lags in the amount of fish being traded in the district corresponded directly with periods of rough sea conditions, as for example in the months of November-December when unpredictable winds intensify. During such periods only fishers with large boats could continue fishing.

3.4 Organisation along the market chain

The institutional arrangements that determined how and why fish changed hands were examined along sections of the market chain: the production sphere where fish are caught, landed and shared, and the trade and transit sphere where economic transactions led fish towards consumer bases.

Organization at the catch land site

Fishing capacity in Beacou varied among households, which meant supply of fish to the market chain was not uniform across primary suppliers. Three households belonging to Beacou's founding lineage

showed a disproportionately high fishing capacity. The community's customary and administrative leadership at the time of field research centred around these same households. While the average household boat ownership in Beacou was one boat per household, each of these households owned at least four boats. With more boats and more advanced gear and skills, these households collectively had a far higher fishing capacity. Middlemen in Beacou confirmed that the majority of their traded catch from Beacou came from a small group of boats that had superior gear and skills.

Village-bound transactions of fish in Beacou reflected important social accountabilities people had within their immediate social (kinship) circles and within the broader community. Whereas fishing from dugout canoes was more often a solitary activity, fishing from motorized vessels involved groups of 2-3 people. Various arrangements were applied for benefit sharing amongst the crew. In cases where all crew members were from the same nuclear household, income was managed through the household; if crew members were from separate households, income was most often shared equally after costs for fuel and maintenance were subtracted.

As noted elsewhere in Timor-Leste, in Beacou particular socio-cultural institutions highly influenced a person's engagement and place in society; including their association to ancestral house (*uma lulik*) and inter-family kinship relations *(umane-fetosaan*, 'wife giving'-'wife taking' clans) (see also McWilliam 2011; ten Brinke 2018). Although fish played no substantial part in ritual meat exchanges, as part of customary practices around marriage, death or conflict resolution (see also McWilliam 2011; Alonso Población 2013), fish were important in strengthening social capital within and among households. All fishers noted that a portion of their catch was kept aside for home consumption and/or gifted to close friends or kin. For fish gifting across inter-family relations, for example, many fishers noted dutiful gifting to their *umane* (wife-giving clan, i.e. wife's family) relations, as part of their *manefoun* (son in law) role in the relationship.[3] The size of any kind of gifted fish varied according to the catch size (with large catches often seeing generous gift giving) and personal or communal circumstances (with directed gifting to households experiencing a family tragedy or more frequent widespread gifting in times high food insecurity). As one fisher noted 'sometimes, like in low [fishing] season when it is difficult for many of us, I still share some of my catch even though I could have sold it to get money [...] this is what makes us a strong village'. Sharing practices were not always experienced as voluntary, as some respondents noted how moral expectations for sharing practices among recipients resulted in social pressure to share. Occasionally, fishers avoided social obligations around in-village transactions by selling their fish to roadside restaurants along the coastal

[3] *Umane fetosaan* relations between families are characterised by entitlements bestowed on *umane* as 'wife givers'(i.e. wife's family) and *fetosaan* as 'wife takers' (i.e. husbands family), and duties assigned to *manefoun* (son in law). The latter reflects a directional power relation that is based on recognition of *umane*'s efforts and sacrifices in raising the wife. With various marriage relations associated to a family, people typically hold both positions, resulting in a somewhat even distribution of taking and receiving roles (see also Ospina and Hohe 2002; McWilliam 2011; ten Brinke 2018).

highway before reaching the Beacou landing site, particularly if the day's catch was small. Trade of fish among households also occurred when there was surplus fish in the household and involved women only. Price negotiations in these cases often settled on sub-market prices as a gesture of kindness among peers or to avoid the risk of being perceived as greedy or unfair. Transactions among members of the same community indicated strongly that fish represented both social and economic currency.

Unlike other villages, Beacou fishers traded exclusively to Beacou collectors and traders; this was bounded to varying extents by local social and economic relations. As with fishing capacity, the entrenched social order among households in Beacou differentiated capacity among traders and collectors. At the time of research there were 15 households involved in trade in Beacou, however three of those were by far the largest, assuming an estimated 80-90% of fish trade out of Beacou, according to fishers. These three households operated as collectors, and had comparatively more capital to buy fish, maintained larger networks with traders in Maliana and Dili, and had capacity to make ice for storage/transport. Their most reliable supply from boats owned by them or their close kin with whom exclusive trade was agreed. In addition, primary trade with independent fishers, primarily from Beacou but also some from neighbouring communities to the east, was highly important. All three collectors maintained arrangements with certain fishers that meant they reserved their trade with them. While some such arrangements were based on repaying debt, most appeared loose and subject to change much in line with other cases discussed in the literature (Crona et al. 2010; Wamukota et al. 2015; Drury O'Neill et al. 2018). The few observations of patron-client relationships, were by no means comparable to the kind of dependency relationships recorded elsewhere in the southeast Asia where coercive patron practices locked fishers in perpetual poverty traps (Miñarro et al. 2016). All fishers interviewed in Beacou who shared no direct family ties to one of the three big middlemen, noted they felt free to choose which middleman they sold their fish to. Some noted they had preference to sell to those they were familiar with and who, out of experience, consistently honoured fair price for the catch, while others noted they sold to whomever was at the catch landing site to buy the fish first.

Although fish trade occurred at the catch landing site, the transfer of money between hands never occurred there. On agreeing a price, middlemen often completed the transaction at the homes of fishers, whereby the wives played important roles in accepting and managing household finances. Several fishers spoke of arrangements with their wives whereby the wives paid a share to the husband after completing the transaction and subtracting needs for the household. As one fisher noted, 'I sell the fish to my wife and she then sells it to the middleman so that profit can be used in the household'. Such internal household arrangements were common among fishers, but not consistent across all households.

There were very few cases of fish commodities deviating from trade paths through in-village traders or collectors. For example, just prior to the time of fieldwork a pilot project geared towards promoting value adding activities had been initiated by an external NGO. Through provision of training and materials, a women's group in Beacou was organized to buy sardines to produce quality fish-based products for sale to upmarket Dili (e.g. preserved sardines in oil and dried fish food garnish). These activities however still proved strongly dependant on impetus from the external NGO to organize transport, negotiate market connections with supermarkets and provide necessary materials and quality control to ensure upmarket standards.

Organisation in the trade and transit sphere

The dominant village collectors formed the most prominent points through which commodities left the supply base. Fish was typically sold with a 10-25% mark-up, depending on the outwards sale channel. Road side sales saw the most variable, but also the largest, price increments with up to 25% at times, particularly in the morning when middlemen were more willing to risk asking higher prices from commuters given the prospect of remaining opportunity in the day ahead. Sales by the bucket to mobile Maliana traders had the most consistent price increment, estimated around 10%. The daily frequency of trade was noted to be a strong stabilising factor in these transactions. Collectors' and traders' door-to-door sales yielded a 15-20% increase whereby fish were sold per tally of four or six fish depending on the type of fish. Bulk sales of between 200-400 kilograms of fish by village collectors to those in Dili or Maliana were specifically negotiated and were typically sold with a 10-15% price increment. Such sales were considerable and could deliver revenue of up to 800-1000 USD each. One of three dominant collectors noted he would at times arrange transport of bulk catch to Dili himself and personally sell the catch to vendors at the urban market, thus circumventing Dili collectors.

Village collectors all noted the importance of ensuring a consistent fish supply to traders and market centre collectors, so as to gain a market advantage by reputation. On days of small or no catch for example, all three dominant collectors noted to have occasionally sent their fishing boats to Indonesian border waters to buy directly off Indonesian purse seine fishers who were said often drive up prices in such transactions. This was mainly to fulfil demands by market centre collectors. One village collector noted that 'saying we have no fish means they will go to other collectors to buy fish […] if I say I do not have fish too often he will stop phoning, so I buy fish from Indonesia […] and even sell at a loss sometimes.'

Mobile motorbike traders from Maliana bought fish from village middlemen and sold at a similar 10% mark-up, typically in piles of three to five fish, depending on the size of the fish, at market stalls or door-to-door. Many of the mobile traders also operated in family units, with one to three motorbikes

operating within a family business. Traders paid a daily stall fee at the Maliana fish market to be able to sell their fish.

Collectors from Dili coordinated trade across larger distances and with more capacity, and often by prearranged contact with strategically located village collectors, like those in Beacou. At the time of research three main Dili-based collectors coordinated trade along the north coast, west of Dili. Purchases of larger fish species catered for sales to supermarkets (where they were sold to consumers frozen), restaurants and market vendors at central markets. With exception of special trade arrangements made when big catches were reported, the trade between these three Dili collectors appeared mutually coordinated, whereby each made two runs a week from Dili to the border on separate days so that everyday a trade run was made. These collectors claimed also to make runs along fishing villages to the east of Dili towards Baucau on alternate days. Illegal trade of fish across the border often entered Dili market through these channels, although periodic border police interceptions at times temporarily terminated this supply.

3.5 Implications for rural development support

Our findings show that the entrepreneurial capacity of influential market actors, the social capital among them and the local ingenuity to overcome barriers appear decisive in how trade and distribution occurs in Bobonaro. Significant efforts by the government and their development partners to improve distribution, fish-quality, regulation and equitability of supply chains remain challenged by limited available resources, budget, staff and the need to deliver outcomes short periods of time. Below we examine what alternative channels could be pursued to help improve availability and access of fish.

Appreciating the fundamental dynamics of rural development that includes both broader contextual (non-fisheries) development trends and more sectoral activities (Harriss 1982; Barr et al. 2019), can offer guidance for more effective support. Morse and McNamara (2013) revisited seminal work on rural development studies of the 1990s and referred to two basic forms of development: immanent and intentional development. The former refers to broader (non-fisheries) enabling development progressions that occur ‘in the background’ (i.e. outside of community-based projects), like construction of roads, while the latter refers to interventions by community-based projects directed at specific fisheries outcomes, like the construction of a fisheries centre. These forms are by no means mutually exclusive; on the contrary, they “can and do occur in parallel, with ‘Immanent’ development providing a broad background of change in societies while ‘Intentional’ development takes place as planned intervention” (Morse and McNamara 2013: 15). The enabling environments resulting from, for example, improved roads and communication technology, encourage broad rural development and modernisation. These are not necessarily fisheries related, but influence how SSF and fish distribution

networks operate. From this perspective, directed (intentional) fisheries interventions have a critical twofold role to play: namely to (i) recognize and harness broader trends in favour of, for example, sustainable fisheries management that addresses livelihood needs and food insecurity and to (ii) ensure that spin-offs from broader development empower a broad base rather than perpetuate inequality, marginalization or elite capture.

In avoiding implementation of 'blueprint' solutions into specific rural contexts, an alternative vehicle for development is to learn about—and build on—local practices, skills and networks (e.g. Moser 1998) to ensure interventions integrate into local life (Johnson et al. 2013; Béné et al. 2016). McGoodwin (2001) similarly argues that a critical first step for achieving meaningful development progress in small scale fisheries is gaining detailed understandings of local social systems.

Finding local solutions to local challenges requires commitment to people and places, with a process—rather than output— oriented approach to development (Long 2001). Time spent building legitimacy and trust through local relationships and learning who the 'movers and shakers' are on the ground, is fundamental to identifying feasible avenues to beneficial intervention (Steenbergen and Warren 2018). Local avenues in Timor-Leste may offer opportunities to addressing the major challenges facing effective management of coastal fisheries for food security there. To do so requires firstly the assurance that good quality fish reaches consumers (Alonso Población et al. 2012). The various initiatives to upgrade fish distribution in rural Timor-Leste, through for example developing ice production and distribution nodes (Lentisco et al. 2013), related to legitimate food safety concerns around unhygienic fish handling and preservation practices (Alonso Población et al. 2012). The challenging rural conditions, particularly around the availability and quality of water and electricity, hampered the rollout of cold chain infrastructure development. However, signs of resourcefulness among local actors offer opportunities to overcome such barriers. Local trading actors, like the larger collectors in Beacou and Maliana, showed to have organized themselves by investing in freezers to make ice as part of their enterprise. In a feasibility study on hygienic production of ice for the SSF sector in Timor-Leste, Christensen (2010a, p. 10) similarly noted, 'the fish traders […] are in some cases better organized […]. Some have seen benefits from establishing the cold chain by using ice […]. Some traders/investors have invested in a bank of chest freezers for this purpose [ice production]'. Such traders may provide useful entry points for public-private sector engagements geared towards bolstering ice distribution in remote rural areas, as an alternative to investment in cold chain infrastructure.

Equally important for effective management of SSF of food security is reliable primary data to inform decision making. As evident from our findings, and as noted by Christensen (2010a), local traders are influential actors, who, if engaged appropriately, may enable data collection and quality control interventions to be embedded more in the social reality of Timor-Leste's fish catch, trade and consumption. Common criticism of approaches utilising influential local actors points to potential that

entrenched patronage and elite capture is exacerbated. Custom-based institutions in Timor-Leste society, however, encompass potentially effective control mechanisms to ensure socially just practices and equitable benefit distribution. This is evident in the way customary social structures in Beacou influence village leadership, fishing capacity and how fish catch is distributed.

Ongoing efforts by the Timor-Leste government to empower local social institutions through decentralization and integration of local custom-based law with central State law (Democratic Republic of Timor-Leste 2011; Alonso Población et al. 2013) can enable socially-embedded development support. Listening to local ideas and aspirations, and co-designing appropriate responses, needs to be met with an open agenda whereby the diverse range of rural development agencies' disciplinary boundaries should minimally compromise what kind of investment is directed into local systems. Critical to this is sufficient cross-fertilization between sectors in the delivery of development (Steenbergen et al. 2017). Silos of healthcare, transport infrastructure, resource management and agriculture for example promote isolated interventions that fail to account of how interventions fit in the actual social contexts people live in (which are far more mixed, messy and cross disciplinary). The Timor-Leste government is uniquely positioned to integrate sectors into its national rural development strategy, both at higher-level national policy design and ground-level community development. Rural fisheries support programs on their part must then address on whether their interventions are indeed consistent with broader development progressions outside of the fisheries sector.

4. CONCLUSION

In this study we have explored fish distribution patterns across social networks reaching from a catch landing site in Beacou into Bobonaro district, in western Timor-Leste. This study advances understandings of the social workings of domestic market chains in developing contexts, like in Timor-Leste, and how fish commodity-flows function through relationships between producers, traders and consumers. In doing so, we considered how such understandings can inform rural development strategies to support fisheries for food security in Timor-Leste. Initiatives by the government and their development partner agencies to improve fish production and distribution remain challenged by limited resources, staff and time. This is where a deeper understanding of the distribution networks' social workings, and the diverse roles of actors involved, provides opportunity to identify alternative entry points for intervention and important local institutions that can institute improvements.

Trade in places like Bobonaro reflects considerable local capacity to deal with a range of fish distribution challenges through social networks, local trading practices and ingenuity of market actors. Local peoples' capacities, and the priority areas in which they choose to invest time and resources,

683 have come to produce trading practices and market chains that determine where fish are transported
684 to, and how benefits are derived along those chains. Development objectives to improve access and
685 availability of nutritious fish often means fish needs to be traded more, further and more consistently.
686 To do so, this case from Timor-Leste illustrates how building on and improving what people are
687 already doing, how and with whom, in ways that are locally familiar and allow new adjustments to
688 become part of local social life, is more likely to deliver lasting impacts beyond project time frames.
689 The roles of central government and its development partners remain important through acting at
690 useful entry points in distribution networks, designing support approaches and contextually-relevant
691 interventions that can be locally 'owned' and implemented, and ensuring there are effective control
692 mechanisms in place for fair and equitable outcomes.

693

694 **5. CONFLICT OF INTEREST STATEMENT**

695 The authors declare that they have no conflict of interest.

696

697 **Informed consent:** Informed consent was obtained from all individual participants included in the
698 study.

699

700 **Human ethics approval:** All procedures performed in the study involving human participants were in
701 accordance with the ethical standards of the institutional and/or national research committee (Charles
702 Darwin University Human Research Ethics Committee, H14084) and with the 1964 Helsinki
703 declaration and its later amendments or comparable ethical standards.

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705 **6. REFERENCES**

706 Alonso-Población, E., Fidalgo-Castro, A., & Pena-Castro, M. J. (2018a). Bargaining Kultura: tensions
707 between principles of power acquisition in contemporary Timor-Leste. *Sociologus, 68*(2),
708 107-124, doi:10.3790/soc.68.2.107.

709 Alonso-Población, E., Rodrigues, P., Wilson, C., Pereira, M., & Lee, R. U. (2018b). Narrative
710 assemblages for power-balanced coastal and marine governance. Tara Bandu as a tool for
711 community-based fisheries co-management in Timor-Leste. *Maritime Studies, 17*(1), 55-67,
712 doi:10.1007/s40152-018-0093-9.

713 Alonso Población, E. (2013). Fisheries and food security in Timor-Leste: the effects of ritual meat
714 exchanges and market chains on fishing. *Food Security, 5*(6), 807-816, doi:10.1007/s12571-
715 013-0308-2.

716 Alonso Población, E., Rodrigues, P., & Lee, R. (2013). Tara Bandu as a coastal and marine resource
717 management mechanism: a case study in Biacou, Timor-Leste. In S. V. Siar, & D. Kalikoski
718 (Eds.), *Strengthening organizations and collective action in fisheries Towards the formulation*
719 *of a capacity development programme- Workshop report and case studies 4-6 November* (pp.
720 301-340). Barbados: FAO Regional Office for Asia and the Pacific.

721 Alonso Población, E., Wilson, C., Rodrigues, P., Pereira, M., & Griffiths, D. (2012). Policy and
722 practice: recommendations for sustainable fisheries development in Timor-Leste. Bangkok:
723 FAO Regional Fisheries Livelihoods Programme for South and Southeast Asia

724 AMSAT International (2011a). Fish and animal protein consumption and availability in Timor-Leste.
725 Rome: FAO Regional Fisheries Livelihoods Programme for South and Southeast Asia
726 (GCP/RAS/237/SPA)

727 AMSAT International (2011b). Report on Fisheries Livelihoods Baseline Survey in Timor-Leste.
728 Rome: FAO Regional Fisheries Livelihoods Programme for South and Southeast Asia
729 (GCP/RAS/237/SPA)

730 Andersen, A. B., Pant, J., & Haraksingh Thilsted, S. (2013). Food and nutrition security in Timor-
731 Leste. Canberra: Aquatic Agriculture Systems, CGIAR.

732 Andrew, N., Kam, S. P., & Philips, M. (2011). Mapping fisheries dependence and aquaculture
733 development in Timor-leste: a scoping study. (pp. 1-22). Jakarta, Indonesia: Coral Triangle
734 Support Partnership.

735 Aspinall, E., Hicken, A., Scambary, J., & Weiss, M. (2018). Timor-leste votes: Parties and patronage.
736 *Journal of Democracy, 29*(1), 153-167, doi:10.1353/jod.2018.0013.

737 Bailey, C., & Jentoft, S. (1990). Hard choices in fisheries development. *Marine Policy, 14*(4), 333-
738 344, doi:https://doi.org/10.1016/0308-597X(90)90055-V.

739 Barr, R., Bruner, A., & Edwards, S. (2019). Fisheries Improvement Projects and small-scale fisheries:
740 The need for a modified approach. *Marine Policy, 105*, 109-115,
741 doi:https://doi.org/10.1016/j.marpol.2019.02.053.

742 Béné, C., Arthur, R., Norbury, H., Allison, E. H., Beveridge, M., Bush, S., et al. (2016). Contribution
743 of fisheries and aquaculture to food security and poverty reduction: assessing the current
744 evidence. *World Development, 79*, 177-196, doi:10.1016/j.worlddev.2015.11.007.

745 Chambers, R., & Conway, G. R. (1992). Sustainable rural livelihoods: practical concepts for the 21st
746 century. *Discussion paper 296*. Brighton: Institute of Development Studies.

747 Chambers, R., Pacey, A., & Thrupp, L. A. (1989). *Farmer first: farmer innovation and agricultural*
748 *research*. London: Intermediate Technology Publications.

749 Christensen, M. B. (2010a). Feasibility study on hygienic production of ice for the small scale
750 fisheries sector in Timor-Leste. Rome, Italy: United Nations Food and Agriculture
751 Organization - Regional Fisheries Livelihoods Programme for South and Southeast Asia
752 (GCP/RAS/237/SPA).

753 Christensen, V. (2010b). MEY = MSY. *Fish and Fisheries, 11*(1), 105-110, doi:10.1111/j.1467-
754 2979.2009.00341.x.

755 Crona, B. I., Basurto, X., Squires, D., Gelcich, S., Daw, T. M., Khan, A., et al. (2016). Towards a
756 typology of interactions between small-scale fisheries and global seafood trade. *Marine*
757 *Policy, 65*, 1-10, doi:10.1016/j.marpol.2015.11.016.

758 Crona, B. I., Nyström, M., Folke, C., & Jiddawi, N. (2010). Middlemen, a critical social-ecological
759 link in coastal communities of Kenya and Zanzibar. *Marine Policy, 34*(4), 761-771,
760 doi:http://dx.doi.org/10.1016/j.marpol.2010.01.023.

761 da Costa, M., Lopes, M., Ximenes, A., Ferreira, A. d. R., Spyckerelle, L., Williams, R., et al. (2013).
762 Household food insecurity in Timor-Leste. *Food Security, 5*(1), 83-94, doi:10.1007/s12571-
763 012-0228-6.

764 Democratic Republic of Timor-Leste (2017). National food and nutrition security policy. Dili:
765 Democratic Republic of Timor-Leste.

766 Democratic Republic of Timor-Leste (2014). National Food and Nutrition Security Policy. Dili:
767 Democratic Republic of Timor-Leste.

768 Democratic Republic of Timor-Leste (2011). Timor-Leste strategic development plan, 2011-2030.
769 Dili: Democratic Republic of Timor-Leste.

770 Drury O'Neill, E., Crona, B., Ferrer, A. J. G., Pomeroy, R., & Jiddawi, N. S. (2018). Who benefits
771 from seafood trade? A comparison of social and market structures in small-scale fisheries.
772 *Ecology and Society, 23*(3), doi:10.5751/ES-10331-230312.

773 Fabinyi, M., Dressler, W. H., & Pido, M. D. (2017). Fish, trade and food security: moving beyond
774 'availability' discourse in marine conservation. *Human Ecology, 45*(2), 177-188,
775 doi:10.1007/s10745-016-9874-1.

776 Feidi, I. H. (2005). The fisheries of Zanzibar: Potential for new investments. *Worldfish Center*
777 *Quarterly, 28*(3), 37-40.

778 Fluet-Chouinard, E., Funge-Smith, S., & McIntyre, P. B. (2018). Global hidden harvest of freshwater
779 fish revealed by household surveys. *Proceedings of the National Academy of Sciences,*
780 *115*(29), 7623-7628, doi:10.1073/pnas.1721097115.

781 Food and Agriculture Organization of the United Nations (2009). Fishery and aquaculture country
782 profiles: The Democratic Republic of Timor-Leste. Rome: Food and Agriculture Organization
783 of the United Nations (FAO).

784 General Directorate of Statistics, Ministry of Health, & ICF (2018). Timor Leste Demographic and
785 Health Survey 2016. Dili, Timor Leste and Maryland, USA: GDS and ICF.

786 Gillett, R. E. (2010). Fisheries centres in the Pacific Islands: lessons learned? *SPC Fisheries*
787 *Newsletter, 133*, 29-34.

788 Grafton, R. Q. (2005). Social Capital and Fisheries Governance. *Ocean and Coastal Management,*
789 *48*(9-10), 753-766.

790 Harriss, J. (1982). *Rural development: theories of peasant economy and agrarian change* (Hutchinson
791 university library for Africa). London: Hutchinson.

792 Hosgelen, M., & Saikia, U. (2016). Timor-Leste's demographic challenges for environment, peace
793 and nation building. *Asia Pacific Viewpoint, 57*(2), 244-262, doi:10.1111/apv.12117.

794 Jentoft, S., & Chuenpagdee, R. (2009). Fisheries and coastal governance as a wicked problem. *Marine*
795 *Policy, 33*(4), 553-560, doi:https://doi.org/10.1016/j.marpol.2008.12.002.

796 Johnson, A. E., Cinner, J. E., Hardt, M. J., Jacquet, J., McClanahan, T. R., & Sanchirico, J. N. (2013).
797 Trends, current understanding and future research priorities for artisanal coral reef fisheries
798 research. *Fish and Fisheries, 14*(3), 281-292, doi:10.1111/j.1467-2979.2012.00468.x.

799 Kirby, F., & Di'ak, E. (2018). Supply chain analysis: availability of fresh fish and fish products in
800 landlocked municipalities in Timor-Leste. Dili, Timor Leste: Empreza Di'ak.

801 Kittinger, J. N., Teneva, L. T., Koike, H., Stamoulis, K. A., Kittinger, D. S., Oleson, K. L. L., et al.
802 (2015). From reef to table: social and ecological factors affecting coral reef fisheries, artisanal
803 seafood supply chains, and seafood security. *PLoS ONE, 10*(8), e0123856,
804 doi:10.1371/journal.pone.0123856.

805 Lentisco, A., Rodrigues, P., Pereira, M., Needham, S., & Griffiths, D. (2013). Case study: supporting
806 small-scale fisheries through the reactivation of fish-landing centres in Timor-Leste. Dili:
807 Regional Fisheries Livelihoods Program (RFLP) for South and Southeast Asia - Food and
808 Agriculture Organization (FAO).

809 Long, N. (2001). *Development Sociology: Actor Perspectives*. London and New York: Routledge.

810 Madison, D. S. (2005). *Critical Ethnography: Methods, Ethics and Performance* (1st ed.). Thousand
811 Oaks, London and New Delhi: Sage Publications.

812 McClanahan, T., Allison, E. H., & Cinner, J. E. (2015). Managing fisheries for human and food
813 security. *Fish and Fisheries, 16*(1), 78-103, doi:10.1111/faf.12045.

McGoodwin, J. R. (2001). Understanding the cultures of fishing communities: A key to fisheries management and food security. *FAO Fisheries Technical Paper* (pp. 1-287). Rome: Food and Agriculture Organization of the United Nations.

McGregor, A. (2007). Development, foreign aid and post-development in Timor-Leste. *Third World Quarterly, 28*(1), 155-170, doi:10.1080/01436590601081955.

McWilliam, A. (2011). Exchange and resilience in Timor-Leste. *Journal of the Royal Anthropological Institute, 17*(4), 745-763, doi:10.1111/j.1467-9655.2011.01717.x.

McWilliam, A. (2002). Timorese Seascapes: Perspectives on Customary Marine Tenures in East Timor. *The Asia Pacific Journal of Anthropology, 3*(2), 6-32, doi:10.1080/14442210210001706266.

Mills, D. J., Abernethy, K. A., King, J., Hoddy, E. T., Teoh, S. J., Larocca, P., et al. (2013). Developing Timor-Leste's coastal economy: Assessing potential climate change impacts and adaptation options. *Final report to the Australian Government Coral Triangle Initiative on Coral Reefs, Fisheries and Food Security National Initiative* (pp. 1-142). Penang, Malaysia: WorldFish.

Mills, D. J., Tilley, A., Pereira, M., Hellebrandt, D., Pereira Fernandes, A., & Cohen, P. J. (2017). Livelihood diversity and dynamism in Timor-Leste: insights for coastal resource governance and livelihood development. *Marine Policy, 82*, 206-215, doi:10.1016/j.marpol.2017.04.021.

Miñarro, S., Navarrete Forero, G., Reuter, H., & van Putten, I. E. (2016). The role of patron-client relations on the fishing behaviour of artisanal fishermen in the Spermonde Archipelago (Indonesia). *Marine Policy, 69*, 73-83, doi:http://dx.doi.org/10.1016/j.marpol.2016.04.006.

Molyneux, N., da Cruz, G. R., Williams, R. L., Andersen, R., & Turner, N. C. (2012). Climate Change and Population Growth in Timor Leste: Implications for Food Security. *Ambio, 41*(8), 823-840, doi:10.1007/s13280-012-0287-0.

Morse, S., & McNamara, N. (2013). The theory behind the sustainable livelihood approach. In S. Morse, & N. McNamara (Eds.), *Sustainable livelihood approach: A critique of theory and practice* (pp. 15-60). Dordrecht: Springer.

Moser, C. O. N. (1998). The asset vulnerability framework: Reassessing urban poverty reduction strategies. *World Development, 26*(1), 1-19, doi:https://doi.org/10.1016/S0305-750X(97)10015-8.

NDFA (2013). Timor-Leste national aquaculture devlopment strategy 2012-2030. Dili, Timor Leste: National Directorate of Fisheries and Aquaculture (NDFA).

Ospina, S., & Hohe, T. (2002). *Traditional power structures and local governance in East Timor: a case study of the Community Empowerment Project (CEP)* (Études courtes, Vol. 5). Geneva: Graduate Institute of Development Studies.

Overå, R. (2011). Modernisation Narratives and Small-Scale Fisheries in Ghana and Zambia. *Forum for Development Studies, 38*(3), 321-343, doi:10.1080/08039410.2011.596569.

Palmer, L., Niner, S., & Kent, L. (Eds.). (2006). *Exploring the Tensions of Nation Building in Timor-Leste* (School of Social and Environmental Enquiry, Vol. 1). Melbourne: University of Melbourne.

Roxas, H. B., & Azmat, F. (2014). Community social capital and entrepreneurship: analyzing the links. *Community Development*, 1-16, doi:10.1080/15575330.2014.880495.

Steenbergen, D. J. (2016). Strategic customary village leadership in the context of marine conservation and development in southeast Maluku, Indonesia. *Human Ecology, 44*(3), 311-327, doi:https://dx.doi.org/10.1007/s10745-016-9829-6.

Steenbergen, D. J., Clifton, J., Visser, L. E., Stacey, N., & McWilliam, A. (2017). Understanding influences in policy landscapes for sustainable coastal livelihoods. *Marine Policy, 82*, 181-188, doi:http://dx.doi.org/10.1016/j.marpol.2017.04.012.

Steenbergen, D. J., & Warren, C. (2018). Implementing strategies to overcome social-ecological traps: the role of community brokers and institutional bricolage in a locally managed marine area. *Ecology and Society, 23*(3), doi:http://dx.doi.org/10.5751/ES-10256-230310.

ten Brinke, S. (2018). Citizens by waiting: Timorese young adults between state politics and customary authority. *Citizenship Studies, 22*(8), 882-896, doi:10.1080/13621025.2018.1538318.

Timor-Leste NSD (2015). 2015 Timor-Leste population and housing census: Data sheet. Dili: Timor-Leste National Statistics Directorate.

UNDP (2011). Mobilize social business to accelerate achievement of Timor-Leste MDGs (2012 - 2015). (pp. 28). Dili: United Nations Development Programme - Timor Leste.

von Grebmer, K., Bernstein, J., Nabarro, D., Prasai, N., Amin, S., Yohannes, Y., et al. (2016). Global Hunger Index: Getting to zero hunger. Bonn, Washington, DC, and Dublin: Welthungerhilfe, International Food Policy Research Institute, and Concern Worldwide.

Wamukota, A. W., Brewer, T. D., & Crona, B. I. (2014). Market integration and its relation to income distribution and inequality among fishers and traders: the case of two small-scale Kenyan reef fisheries. *Marine Policy, 48*, 93-101, doi:10.1016/j.marpol.2014.03.013.

878 Wamukota, A. W., Crona, B., Osuka, K., & Daw, T. M. (2015). The Importance of Selected
879 Individual Characteristics in Determining Market Prices for Fishers and Traders in Kenyan
880 Small-Scale Fisheries. *Society & Natural Resources, 28*(9), 959-974,
881 doi:10.1080/08941920.2015.1014600.

882 World Bank (2017). East Asia and Pacific economic update: Timor Leste. In *East Asia and Pacific*
883 *economic update, April 2017* (pp. 164-167). Washington DC.

884 World Bank (2016). Poverty in Timor-Leste 2014. Washington, D.C. : World Bank Group.

885