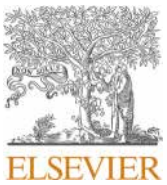
Marine Policy 188 (2026) 107092



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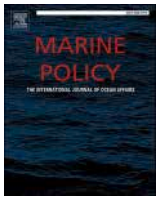

Full length article

Fish trade and distribution from Vanuatu's community-based fisheries

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ARTICLE INFO

Keywords:
Small-scale fisheries
Trade and distribution
Vanuatu
Pacific region
Unregulated trade

ABSTRACT

Small-scale fisheries across the Pacific, particularly in Vanuatu, are multi-species, multi-geared, and span multiple coastal habitats. This diversity and variability extends into associated trade and distribution systems that move fish from relatively few landing sites to broad consumer bases in rural and urban areas. However, little is known about the domestic trade of fish at a national scale, as fish move through connected informal economies that are made up of networks of community and market actors. To help address this gap, this study maps the structure and function of the market systems that coastal fisheries in Vanuatu feed into, and does so by characterizing dimensions of supply, trade and distribution dynamics, and market organization. A framework for mapping fish trade networks is proposed and applied to understand dynamics and variability in the way fish transit. The study sheds light on key areas including the spatial and temporal variation in the distribution of different types of fish, and the considerable dynamism of the fish market system in relation to disruptions. Harnessing domestic trade stands to improve sustainable management, considering its driving role behind fishing as well as people's access to fish. A baseline understanding of trade and distribution can critically support fisheries management authorities to achieve their ambitions to more effectively respond to challenges in improving production, fish storage, and connectivity between fishers and consumers.

1. Introduction

Small-scale fisheries (SSF) support millions of households around the world. As a subset of SSF, tropical community-based fisheries are particularly important for food and nutrition security, income, and as an inherent part of peoples' cultural identity [4]. In the Pacific region, for example, it is estimated that SSF annually contribute over 100,000 t of catch into the regional food system and are worth over USD$260 million [22]. Most SSF in the Pacific region are indeed community-based fisheries and integral to local social and economic structures [11]. These fisheries are multi-species, multi-geared and span multiple habitats from inland to coastal water bodies [5,9,57]. This diversity poses challenges for the monitoring of catch and the associated trade and distribution of fish, particularly in countries with many remote communities.

While there is consensus that the trade and distribution of fish in the Pacific region is integrated into local social and economic networks, little is known about how these market systems function across a landscape. These informal economies tend to function across networks of market actors, and through kin and community relations, and remain under-represented in policy [33]. Studying finfish trade and distribution systems may allow fisheries agencies to better understand these networks and harness linkages to markets and end-consumers, and to governance arrangements [22,29,31,47].

Community-based fisheries in Vanuatu, in a broad sense, involve two categories of fishers: artisanal and subsistence, where the distinction is defined by the purpose or end use of the catch. Subsistence fishers are defined as those who fish for home consumption, sharing and gifting among households, and communal consumption in customary or religious events ceremonies [42]. Artisanal fisheries are defined as those that sell fish to the domestic market [21,38] and are important as a source of income in Vanuatu [22]. In practice, these categories are not strictly mutually exclusive, however, the distinction is useful in understanding their relative contributions to food security and livelihoods at the household level.

This study maps the structure and function of market systems rooted in coastal fisheries in Vanuatu. In developing a typology of fish trade networks in Vanuatu we characterise three main dimensions of trade and distribution, namely fish supply, channels and connections that

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https://doi.org/10.1016/j.marpol.2026.107092
Received 25 January 2025; Received in revised form 25 November 2025; Accepted 17 February 2026
Available online 23 February 2026

make up the distribution system, and finally, actors and organisational trade arrangements of the formal and informal (i.e. unregulated) systems. Analysis was guided by three research questions: (i) What type of fish resources supply Vanuatu's different fish trade networks (*characterising the coastal fisheries supply*)?; (ii) How, where and why are fish traded and transported (*characterising post-harvest fish distribution*)?; (iii) How is fish trade organised and what are the roles of different market actors (*characterising market actors and structural organisation*)? A greater understanding across these dimensions is timely as it contributes to the development of policy and management for fisheries in Vanuatu in support of national development commitments [49].

The study draws on approaches applied in studies of informal fisheries trade [13,28], the conditions and arrangements of trade [15,28,30], the social and economic arrangements within seafood chains [12,23,37], and associated hardships faced by different actors in such trade and distribution networks [35]. The study first introduces the context of SSF in Vanuatu, before outlining the methods behind data collection. Results are structured to outline the three dimensions of fish trade and distribution (supply, distribution and trade structures, and market organisation). These results are then discussed to demonstrate how trade and distribution is unevenly skewed across Vanuatu, is variable by fish category, and is highly dynamic due in part to broader system shifts. Finally, we reflect on the research contribution as a baseline for initiatives seeking to support livelihood and resilience-building interventions for Ni-Vanuatu SSF fishers

1.1. Small-scale fisheries in Vanuatu

Vanuatu is a Small Island Developing State comprised of about 80 islands (Fig. 1). Vanuatu's national economy is concentrated around a

Fig. 1. Map of Vanuatu, indicating the two main urban centres of Port Vila (Efate) and Luganville (Santo), and several provincial market hubs, including Lakatoro (Malekula), Saratamata (Ambae), and Lenakel (Tanna).

limited range of key sectors, including tourism, government services, real estate, agriculture, livestock and commercial offshore fishing [51]. Of the > 300,000 ni-Vanuatu people living in Vanuatu, only 25.9 % live in urban centres [14]. Its national capital, Port Vila, is located on Efate island (Shefa province), and forms one of Vanuatu's two urban centres, with Luganville on Santo Island (Sanma province) being the other. The vast majority of Vanuatu's islands are therefore classified as rural. The country's six provincial administrations are further divided into area councils, with 72 area councils in total. This tiered national government structure determines how government services are made available to people in rural villages.

Per capita consumption of fish is estimated at 25.5 kg per year [54], higher than the global average in 2019 of 20.5 kg [55]. While SSF are not considered a dominant economic sector, they are vitally important to the many hundreds of communities that rely on them in some form for food and/or income [10]. Since independence in 1980, surges in the domestic economy and supportive policy developments have driven rapid growth in the artisanal finfish fishery [3,41,48]. Over time, this fishery has become increasingly mechanized, with fishers using small 5–8 m fishing vessels powered by outboard motors and FAO-developed Samoan hand reels for both vertical dropline fishing and open ocean trolling. This mechanization has enabled further extension of fishing efforts to deeper offshore fishing grounds [32,48]. As a consequence of these developments, coastal fisheries of Vanuatu are estimated to be worth USD 1.5 million [19]. Although participation in the artisanal finfish fishery is not well described, it has been estimated that 49 % of the population engage in some form of pre- and/or post-harvest activities of SSF, the majority of which in rural areas [53]. The national fisheries authority, the Vanuatu Fisheries Department (VFD), licenses deep-bottom snapper and pelagic fishers to fish and sell their catch in the country. There is, however, scant documentation or official records of the number of artisanal fishers beyond these fisheries. A 2018 study estimated that there were around 16,000 small-scale fishers in Vanuatu [2]. Additionally, Gillet and Fong's (2023) regional fisheries sector study estimated that 31 % of households in Vanuatu were engaged in fishing in some form; for subsistence and/or for trade in the informal sector.

Recognising the importance of coastal fisheries for food, nutrition and livelihood security, national policies have, since the early 2000s, shifted from a predominant economic focus towards implementing community-based fisheries management (CBFM) approaches [46]. These approaches build on collaborative arrangements whereby responsibilities are shared between communities and the government, and through that integrate traditional and science-based management concepts [6]. Ultimately, the objective of such co-management is to empower, mobilise and resource communities, to ensure sustainable coastal fisheries [17,40]. While the government's commitment to CBFM is strong, initiatives to operationalise the approach through integration into local informal economies has been largely ineffective at a national scale. In particular, technical and financial difficulties have hampered progress, despite considerable focus on developing village fish markets as seen throughout the Pacific region [20,49].

2. Methods

A mixed-methods approach was used to map the different facets of national fish trade and distribution in Vanuatu. This approach allowed for triangulation and verification across datasets and for critical gap filling [56]. Coastal fisheries in Vanuatu were categorised into two groups based on broad categories of species caught: namely, inshore and reef species (hereafter 'inshore/reef'), and deep-bottom and pelagic species further offshore (hereafter 'deep-bottom/pelagic'). Fishing gear and vessel types also differentiate the two fisheries categories. To characterise coastal fisheries, this study examined four aspects of fishing within these two categories, namely: (i) fishing methods; (ii) means of access to fishing grounds; (iii) catch landing profiles by weight and count of species; and (iv) fish landing variability by island.

National datasets contributed to understanding patterns on community catches and their subsequent primary trade. Qualitative data from trade actors active at various levels provided more context-specific detail on trade and distribution from landing sites through to market hubs. Information from a national solar-powered freezer monitoring program assisted sampling by identifying survey sites. An additional in-depth semi-structured key informant interview with a senior Department of Ports and Harbour (DPH) officer, informed the study of national inter-coastal shipping routes and schedules. The study explicitly sought a nationwide coverage in its analysis in order to capture, where possible, the variability across islands, in terms of fishing and trading behaviour and practically in terms of data availability.

2.1. Secondary data

'*Tails+* ', a national coastal fisheries catch monitoring dataset, provided extensive, but relatively low-resolution, quantitative data [1,27,50]. Although the *Tails+* program has been running since 2017 (https://fame.spc.int/resources/tools/tails, *last visited 20–11–25*), only data since 2020 were used to characterise the SSF sector, because earlier years (pilot phase) and later (COVID-19 pandemic) provided incomplete national level coverage. Furthermore, to improve accuracy, only main islands with greater than 10 recorded *Tails+* trips were included in the analysis. A total of 16,727 fishing trips were used in this analysis. Of the *Tails+* dataset, this study focused on using counts of species, use of catch (i.e. how many were sold at different market types, for consumption or gifting), fishing method, and type of access used by fishers as a proxy for fishing capacity (motorised and non-motorised methods). Catch estimates were based on information collected regularly at landing sites where larger catches (i.e. motorised vessels) tended to be landed. As such, other vessels, including non-motorised canoes that landed their catch at sites closer to their household or at other more convenient access points, may therefore be under-represented.

2.2. Semi-structured interviews with trade actors

Based on VFD's solar-powered freezer monitoring program, 33 fish markets on 13 islands were identified as being active. *Tails+* community monitors provided additional contacts. Further traders were identified through interviews by snowball sampling [56] in order to include unregistered ('informal') traders. Respondents were selected on the basis of criteria designed to capture information relevant to the research questions, e.g. current level of engagement in market hubs (community, provincial and urban centres), and previous engagement with fish trade, and geographic representation across Vanuatu

Semi-structured telephone interviews were guided by questions across two sections. The first enquired about trade activity (buying and selling fish) prior to the COVID-19 pandemic and tropical cyclone Harold, namely in 2019, and the second on trade activities in 2020. The latter section focused particularly on impacts of these two events on their trade activities. The phone interviews with SSF trade actors involved 60 respondents across all six provinces (Table 1).

Interviews were carried out in *Bislama*, the lingua franca of Vanuatu,

Table 1
Respondent location and trade actor category for semi-structured phone interviews.

Province	Fishers	Middlemen-Fisher	Middlemen	Retailers	**Total**
Torba	-	1	-	2	**3**
Sanma	5	5	2	1	**13**
Penama	2	1	-	3	**6**
Malampa	1	5	3	2	**11**
Shefa	6	4	4	3	**17**
Tafea	4	-	-	6	**10**
Total	**18**	**16**	**9**	**17**	**60**

to collect information on fish supply and market sites, traders, types of fish traded, and transport methods used. Informed consent to participate in the interview was sought prior to the interview (data collection was carried out under University of Wollongong ethics reference number 2020/276). Interviews lasted between 20 and 30 min and were recorded with consent of the respondent. At the end of the interview, respondents were asked to identify additional market actors to participate in the research, as part of snowball sampling strategy.

The data sets above were drawn upon to different extents in examining the three dimensions of trade and distribution (fish supply, the dynamics of distribution system, and market system organisation). Examination of the supply end drew primarily from *Tails*+ data. To describe the dynamics of distribution system, including critical infrastructure that defines transit channels through which most fish are distributed in Vanuatu, both data sources were used. Firstly, *Tails*+ data provided information on the species and weight of fish landed, where they were landed and their end use. However, the latter was reported in counts of fish rather than weight. The production data were analysed to describe the catch profiles and fish trade flows, in particular the counts and fish category that were intended for intra- or inter-island sale. Secondly, semi-structured phone interviews with fish trade actors provided information on influential drivers in trade. These data sources offered means to triangulate and identify meaningful patterns of fish trade and distribution. Market system organisation was largely informed by data from the interviews and allowed characterisation of the kinds of trade actors that are active and how they engage across trade and distribution networks.

The lack of a centralised database tracking trade activity, inhibited by the fragmented nature of Vanuatu's islands, made obtaining a representative geographical spread of interviewees challenging. Furthermore, the study was implemented when COVID-19 restrictions were in place, so data acquired were not representative of pre-pandemic years. Limitations on interviewee availability, especially in rural areas, were mitigated by contacting provincial administrators who provided the names of known fish traders and retailers in the provincial centres.

3. Results

3.1. Dimension 1 - supply of Vanuatu's small-scale fisheries

Coastal fisheries in Vanuatu are typically low technology fisheries. In the inshore and reef fishery, spearfishing constituted 40 % of the fishing methods employed by fishers, followed by net fishing and handlining (≈26 % each), with rod and reel constituting the remaining 8 % (Fig. 2). While there was variation across the islands, most of Vanuatu's reef morphology is characterised by narrow fringing reefs with shallow channels and steep reef slopes. This reef structure was reflected in the methods used to catch fish (i.e. spearfishing, net fishing and handlining).

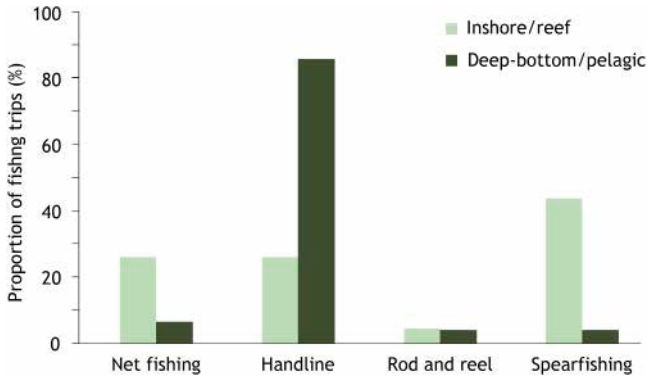

Fig. 2. Proportion of fishing trips using various methods applied across the inshore/reef fishery (light bars) and deep-bottom/pelagic fishery (dark bars).

There was a stronger focus on handlining in deep-bottom/pelagic fishing (Fig. 2), accounting for about 80 % of methods used here, typically around fish aggregating devices (FADs), off deeper reef slopes, or on isolated raised reefs and seamounts.

Access to fishing grounds is a key factor in people's engagement in fishing in Vanuatu, where customary land tenure systems often extend to the fringing reef, thereby determining access rights (see [26]). *Tails*+ data indicated that fishers accessed fishing grounds using motorised vessels, comprising 74 % and 93 % of fishing trips for the inshore/reef and the deep-bottom/pelagic fishery respectively. Non-motorised vessels featured far less (25 % and <10 % respectively), which may be a reflection of either lower productivity and subsistence orientation of this group, or a general lower prevalence of data from this group due to landing site sampling by *Tails*+ .

3.1.1. Catch profiles by weight and count of species per fishery category

The inshore/reef fishery catch was dominated by a large number of small-sized fish, relative to smaller numbers of larger fish from the deep-bottom/pelagic (Table 2). In the inshore/reef fishery, by far the highest cumulative weight landed of any species was of the white-spotted spinefoot (*Siganus canaliculatus*) (28 t), followed by the Indian goatfish (*Parupeneus indicus*) (7 t), and the bluespine unicornfish (*Naso unicornfish*) (5 t). Of the top 10 catches in the deep-bottom/pelagic fishery, skipjack tuna was the most landed species (30 t), followed by the ruby snapper (19 t) and yellowfin tuna (18 t) (Table 2). While the pelagic tuna species of skipjack- and yellowfin tuna are caught by trolling and FAD fishing, respectively, ruby snapper are caught by stationary deep-bottom handlining.

3.1.2. Average catch by island

In 2020, average catches of inshore/reef fishes per trip ranged from 2 to 25 kg. Malekula and Futuna islands recorded the highest average catches of 12 kg and 25 kg per fishing trip, respectively (Fig. 3). For deep-bottom/pelagic fishes, average catches ranged from 4 to 35 kg. Malo, Efate, Futuna, and Pentecost islands all recorded an average of ≥ 20 kgs per trip. Malekula, Ambrym, Epi, Tanna, Aniwa, and Aneityum islands recorded ≥ 10 kgs per trip (Fig. 3).

3.2. Dimension 2 - dynamics and function of post-harvest fish trade and distribution

Fish trade flows are presented at two scales: (i) among islands involving fish chains and networks that connect suppliers, middlemen and consumers in central markets hubs, which accounted for 28 % of landings (119,000 fish); and (ii) within islands, involving single, shorter island-based fish chains and networks spanning area councils and communities, which accounted for 72 %, of landings (300,000 fish). As a basis to the mapping presented in this section, national infrastructure and shipping networks enabling fish distribution are presented since these form the foundation for how fish transit, particularly between islands.

3.2.1. The national inter-island shipping network

Middlemen and other traders involved in both intra-and inter-island fish transport indicated that transport infrastructure was critical in determining the speed, frequency and volume of fish transit. Distribution within an island was primarily dependent on access, where roads and road quality were determining factors. The transport of fish between islands, however, occurred predominantly by boat, although, trivial quantities of fish are transported by plane, for example from Futuna to Tanna Island. Transport of fish between small islands (e.g. from small-island communities to provincial markets on nearby islands) occurred by small artisanal vessels, while access to central market hubs like Port Vila and Luganville, was dependent on the national network of inter-coastal vessels.

Analysis of the national shipping routes of inter-coastal vessels

Table 2
Common, scientific and *Bislama* fish names, total weight (t), count and average weight (kg) of the top ten fish species landed from: (a) the inshore/reef fishery; and (b) the deep-bottom/pelagic fishery.

(a) Inshore/reef fishery					
Common name	Scientific name	Local name	Landed weight (t)	Total count	Mean ind. weight (kg)
White-spotted spinefoot	*Siganus canaliculatus*	Pico	28.0	110,850	0.25
Indian goatfish	*Parupeneus indicus*	Mustas fis	7.4	26,103	0.29
Bluespine unicornfish	*Naso unicornis*	Sanpepa	5.6	5299	1.05
Thumbprint emperor	*Lethrinus harak*	Red maot	5.5	17,045	0.32
Dash-and-dot goatfish	*Parupeneus barberinus*	Mustas fis	4.5	12,995	0.35
Pacific Yellowtail emperor	*Lethrinus atkinsoni*	Red maot	4.4	17,477	0.25
Malabar blood snapper	*Lutjanus malabaricus*	Red snapa	4.3	4311	1.01
Dusky parrotfish	*Scarus niger*	Blu fis	4.2	8372	0.51
Ambon emperor	*Lethrinus amboinensis*	Red maot	4.1	12,367	0.33
Lined surgeonfish	*Acanthurus lineatus*	Renbo	3.7	14,615	0.25
(b) **Deep-bottom/pelagic fishery**					
Common name	Scientific name	Local name	Landed weight (t)	Total count	Mean ind. weight (kg)
Skipjack tuna	*Katsuwonus pelamis*	Skipjak tuna	33.9	15,681	2.16
Ruby snapper	*Etelis carbunculus*	Sotel red poulet	19.3	5560	3.47
Yellowfin tuna	*Thunnus albacares*	Yelofin tuna	18.0	2820	6.39
Longtail red snapper	*Etelis coruscans*	Longtel red poulet	16.9	4480	3.77
Golden eye jobfish	*Pristipomoides flavipinnis*	Yelofin waet poulet	10.6	9725	1.09
Wahoo	*Acanthocybium solandri*	Wahoo	10.0	678	14.69
Mozambique large-eye bream	*Wattsia mossambica*	Bigae brim	7.4	4850	1.53
Saddle-back snapper	*Paracaesio kusakarii*	Kusaka brim	6.0	2838	2.11
Bigeye scad	*Selar crumenophthalmus*	Manguru	5.4	38,772	0.14
Rusty jobfish	*Aphareus rutilans*	Silva poulet	4.3	2041	2.11

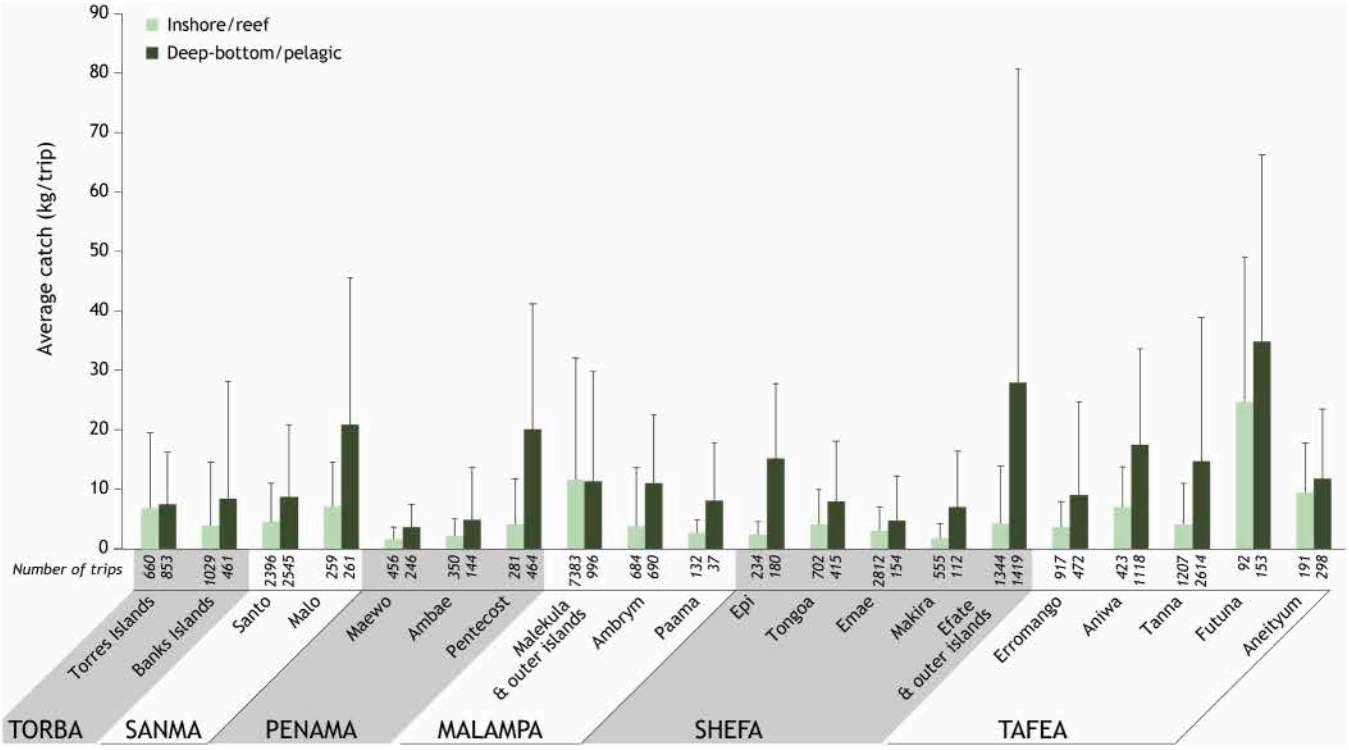

Fig. 3. Average landed fish weight per fishing trip (kg and standard deviation) for the inshore/reef fishery (light bars) and deep-bottom/pelagic fishery (dark bars) across main islands. Numbers below bars are number of fishing trips.

known to transport fish, clarified three distinct distribution channels that varied by frequency and capacity (Fig. 4). The first, and main, channel links the capital city Port Vila to Luganville along a route that connects the provinces of Shefa to Malampa and Sanma along the islands of Efate, Epi, western Ambrym, south and eastern Malekula, and Santo. Landing sites along this route receive more than ten visits per week, more than any other route in the country. Trade along this channel involves mostly agricultural produce such as copra, cocoa and kava (the dried roots of the kava plant are used to make a traditional beverage for sale at local and export markets), imported goods, and coastal finfish. Frequency of port visits and access to urban markets was noted by artisanal fishers and traders as being critical for consistently lucrative fish trade. Besides trade, this route is important for people's mobility for work and education across Vanuatu's most populous centres.

The second distribution channel connected Port Vila market with the southern islands of Tafea province (Fig. 4). Vessel routes to Tafea province form a smaller but significant connection between Port Vila and the islands of Erromango, Aniwa, Futuna, Aneityum and Tanna. In

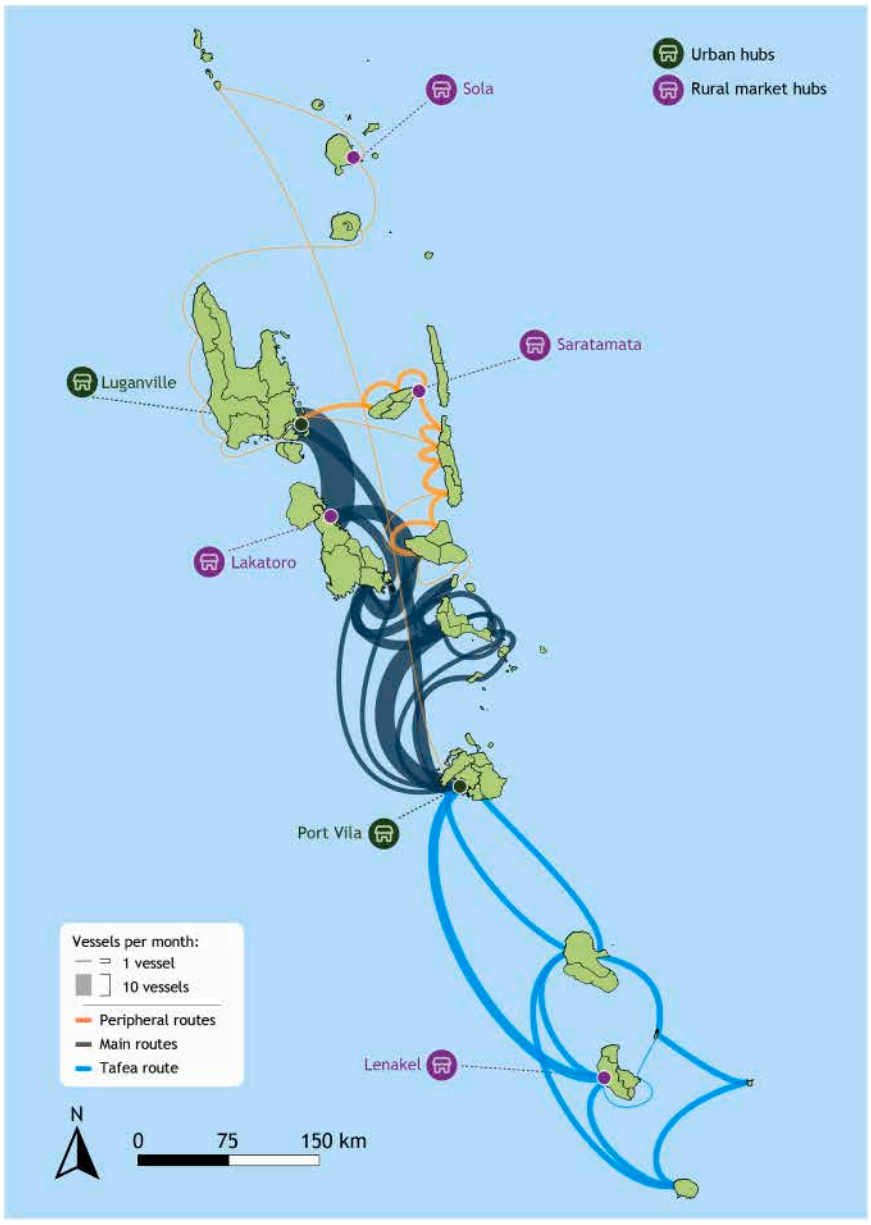

Fig. 4. Scheduled routes of inter-coastal vessels transporting goods, including fish, on a weekly (black), fortnightly (blue) and monthly (orange) basis. Line thickness represents frequency of voyages.

addition, Lenakel is the provincial capital on Tanna and forms the administrative centre and main port linking the aforementioned islands within Tafea. Shipping frequency ranges from four to five voyages per month, transporting passengers and goods, and delivering services around the province. Artisanal fishers and traders in Tafea utilise these shipping schedules to send fish to Lenakel. However, given the lower frequency and capacity of vessels, these trade connections are far smaller than those observed in the main distribution channel between Luganville and Port Vila.

The third and final transport channel operates in the fringing eastern (Penama province) and northern (Torba province) islands. The trade via this route was only peripheral in comparison to the other two distribution channels. Trade intensity was low and connection to the central islands was weak, given ships visit only between one to four times monthly.

3.2.2. *Inter-island fish distribution*

Traders and middlemen reported substantial differences in the way inter-island fish distribution occurs, particularly by associated market demand of the two fish categories, and this was reflected also in *Tails+* data on how fish catches were used. This data includes information on first-point-of-sales only, so does not provide further insights to potential secondary or tertiary sales. Distribution mapping in Fig. 5 is therefore reflective of primary sales and, in that, is disaggregated by the two fish categories of inshore/reef fish, and deep-bottom/pelagic fish. These maps show flow of the proportion of fish sold directly from landing sites to urban markets. While these maps likely underrepresent the total amount of fish going to urban market, given exclusion of secondary and tertiary sales, they does give a relative indication of dominant interisland trade flows. In making sense of distribution patterns, quantitative data on primary sales are supplemented with qualitative insights from

The *Tails+* data included approximately 288,000 inshore/reef fishes recorded as landed in 2020, of which 66 % of primary sales were at rural markets and the remaining 34 % directly at urban markets. Inshore/reef fish, being smaller with lower cost by weight, provide a key source of

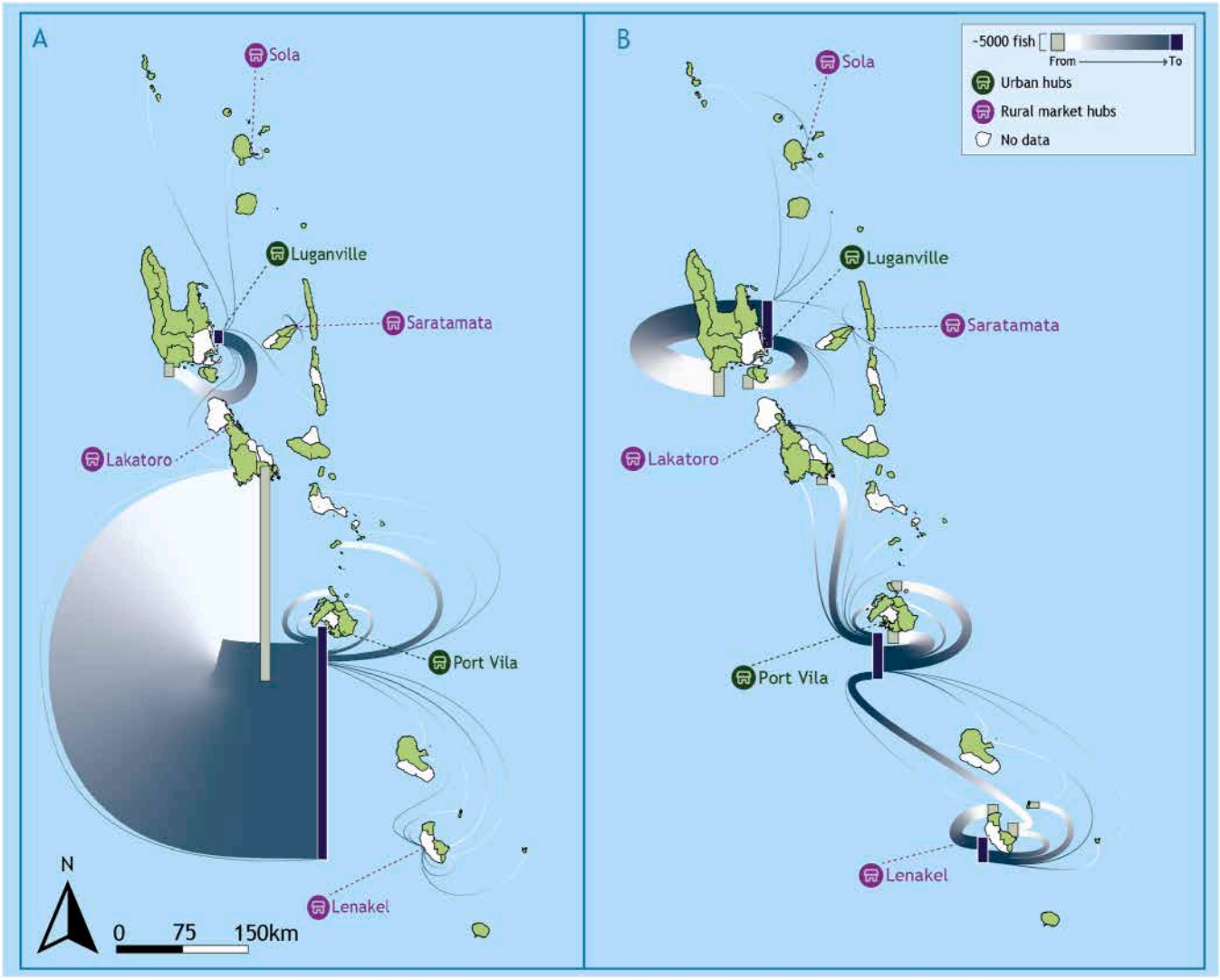

Fig. 5. Number of (a) inshore/reef fish; and (b) deep-bottom/pelagic fish, traded directly across islands in their primary sales. Line colours from white (represents where fish caught and landed) and dark (represents point of sale) (Tails+ data 2020).

protein to both rural and urban households. Aside from the widespread rural distribution there were key channels, through which the majority of inshore/reef fish were traded, namely to the urban centres of Port Vila and Luganville (Fig. 5a). This sustained trade activity reflected high urban demand for affordable fish, facilitated by well-established transport accessibility. In addition to the dominant connection between Malekula and Port Vila, trade and distribution of inshore/reef fish occurred in a number of locations, including Luganville town, and the provincial centres of Lenakel and Saratamata. Major supply sites for inshore/reef fish were found in area councils of South Santo, South Malekula and Makimae. These three supply sites are located within the country's main trade channel and have sheltered anchorages that are frequented by inter-coastal vessels. Fishers and traders in these areas are thus able to sustain artisanal fishing and trading throughout the year.

The *Tails+* data included approximately 131,000 deep-bottom/pelagic fishes recorded as landed in 2020, 71 % of these had primary sales at rural markets and 29 % at urban markets. Trade and distribution patterns of deep-bottom/pelagic fish, between islands, was quite different to the inshore/reef fish category in that the production was widespread, while distribution channels led to almost exclusively the two urban markets (Port Vila and Luganville) and one provincial market (Lenakel) (Fig. 5b). Area councils that were significant producers of deep-bottom/pelagic fish included South Santo and West Malo in Sanma province, South Malekula in Malampa province, North Efate and Eratap in Shefa province, and Waisisi and Aniwa in Tafea province. Deep-bottom/pelagic fish distribution was strongly driven by market demand, whereby decisive factors included market price, tourism and retail demand, and business relationships between traders and retail market actors.

3.2.3. *Intra-island fish distribution*

From a total count of about 419,000 fishes landed, approximately 300,000 (72 %) had primary sales occurring at island level, with the remaining 119,000 (28 %) traded directly outside of the island of landing. Large volumes of fishes are distributed across informal trade networks and consumed by people on the island where the catch was landed. These networks distributed fish across shorter but challenging landscapes, made difficult by poorly maintained road infrastructure on larger islands. Furthermore, islands located outside the central trading channel, including, for example, Vanua Lava in northern Vanuatu and North Erromango in the south, exhibited highly localised fish trade, explained in part due to lack of transport opportunities. (Fig. 6).

There was considerable variation in fish traded per area council (Fig. 6), likely accountable to variations in factors such as population size, livelihood orientation, or household income, but also to sampling effort. Larger islands that host large urban markets in their respective

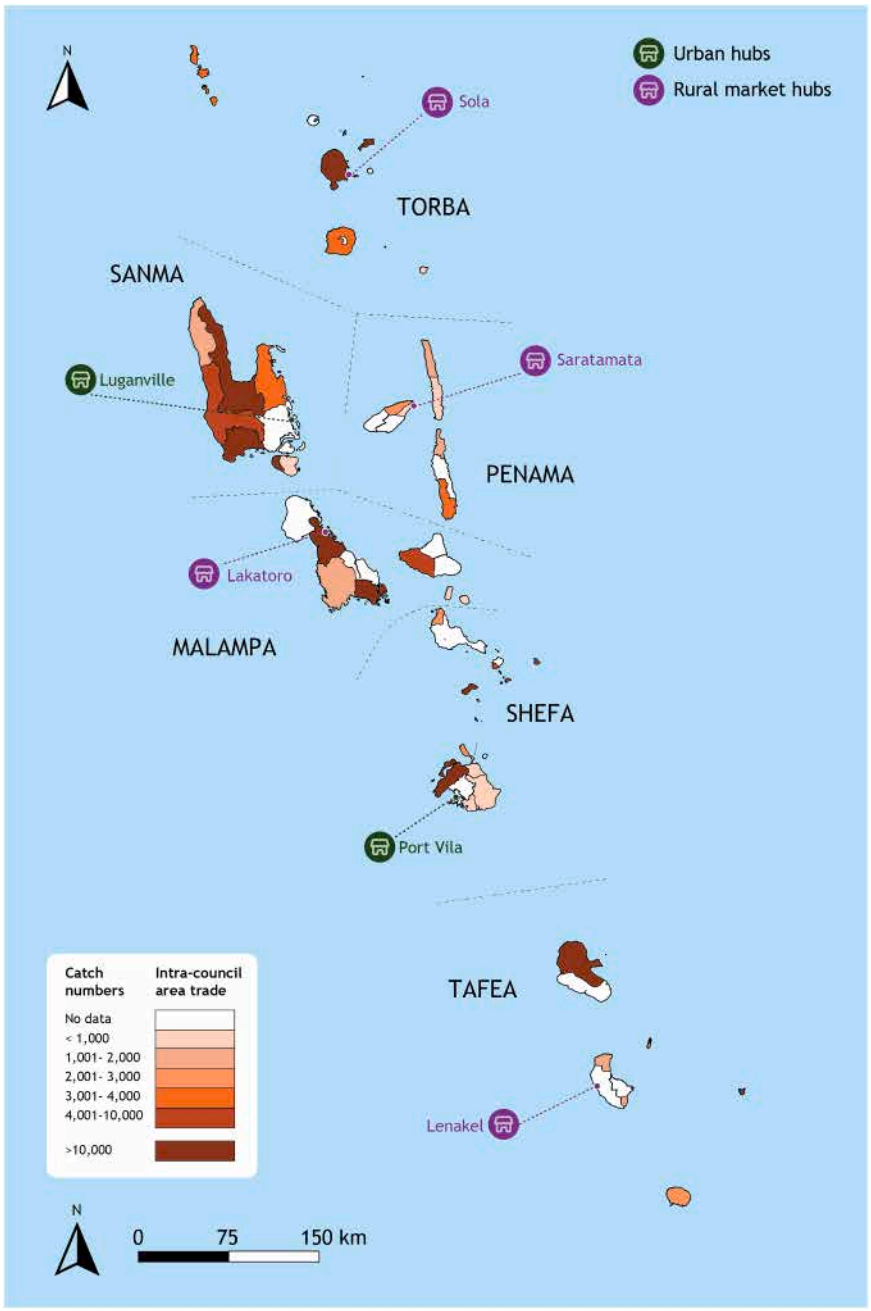

Fig. 6. Local fish trade intensity presented by administrative area council. Blue dots represent the populous urban market hubs of Port Vila and Luganville, while the green dots represent provincial centres that host rural market hubs.

capitals, including Santo, Malekula, and Efate, also have high population densities in their rural areas, leading to high demand for fish. Livelihood orientation is important since islands that have a more agrarian livelihood orientation have fewer per capita active fishers and low local trade such as Pentecost and Maewo islands in Penama province (Fig. 6). On the other hand, area councils with high fish trade had higher fishing capacity associated with higher production. Certain area councils that exhibited low local trade did so due to lower spending capacity.

Fish distribution in rural Vanuatu was primarily influenced by location of commonly used landing sites, and secondarily by availability of cold storage. For example, landing sites such as Sola in east Vanua Lava (Torba province), Tassiriki in southeast Santo (Sanma province) and Craig Cove in southwest Ambrym (Malampa province), serve as centralised supply points between numerous villages. These concentrated landing points attract consumers and traders, with the latter purchasing catch directly from fishers to subsequently on-sell to consumers. These are also ports frequented by inter-coastal vessels, often a few times a month. Arrival and departure times of vessels are periods of bustling activity when villagers, both inland and coastal, gather to receive and/or send goods, or to access rural banking services that operate synchronous to ship schedules. These congregations of people create a spike in in trade of, and local demand for, fish.

Most of Vanuatu's rural communities lack sufficient cold storage facilities. While some have solar-powered freezer infrastructure, limited storage capacity and unreliability due to maintenance requirements and extended cloudy periods were often noted as problematic. Artisanal fishers and traders were often restricted in their ability to reach larger market hubs within the short time frame before fish spoiled. Fishers and traders often sought alternative sale points where demand was high, such as inland villages that have inadequate fish supply. These may be

accessible by public transport, or by foot and wheelbarrow depending on proximity to landing site. In mountainous islands such as Santo and Malekula, inland communities with good road accessibility were noted as being easier and more frequented points of sale. Some artisanal fishers and traders in these areas also capitalised on extended family ties, as well as historical trade links, to sell fish to certain inland communities.

On islands with provincial market hubs (Fig. 6), the intensity of fish trade was higher (i.e. there were more fishing trips occurring and more fish being traded). These market hubs have, over time, increased their economic activity with support from government investment seeking to decentralise services and promote local trade through small businesses and retailers. The presence of fresh produce markets, where agricultural goods are traded on a weekly basis, has ensured sustained consumer demand and further encouraged fishers to supply fish. Interview respondents reported that around these market hubs, small retail shops placed weekly orders directly with fishers, at a higher price than the beach price (price of fish paid at landing site), in order to foster reliable business relationships with fishers.

3.3. Dimension 3 - Structure and organization of fish trade and market system

Interview data from trade actors revealed that the fish-based market system in Vanuatu consists of a complex network of interlinked fish chains that connect different actors (Fig. 7). These actors and the connections among them collectively facilitate the distribution of fish (Fig. 8). From fishers and end-consumers, where geographical barriers among islands and weak infrastructure hamper the effective the transport of fish. Most artisanal fishers lack the capital, capability and/or institutional knowledge to move products from landing sites to market. It is within this context that traders offer an important service by overcoming trade and distribution obstacles to allow regular and consistent fish supply at markets. This service assists in providing much needed income that would otherwise not exist in remote areas.

Two main types of trade actors were identified in Vanuatu, namely 'middlemen'[1] and 'retailers', with sub-classifications within each of these categories (Fig. 7). Middlemen transferred fish from producers to consumers or other traders or retailers. This group may be subdivided into those that are fishers themselves as well (middlemen-fishers), and those that target high value species that require more specialized technology. Middlemen-fishers are distinguished from middlemen in that they also sell fish to consumers in the community where they land, while the middlemen sell to consumers outside the village where they buy the fish from. Middlemen-fishers have social connections in the village that secure sales in village, even though that may only make up a minority of their sold catch. These traders also often invested in improving cold storage capacity (solar-powered freezers), enabling them to trade and ensure consistent supply to markets. Middlemen-fishers are distinct from fishers because the former sell the majority of their catch to traders outside the village, while fishers sell their catch exclusively within the village. Middlemen were found to be most active in urban market hubs and/or within Vanuatu's main central trade channel (Fig. 4). This was evident in south Malekula and south Pentecost where frequent shipping services and suitable road infrastructures enabled them to reliably supply fish to urban and rural inland markets.

Retailers are more place-based actors, located either in community, province or urban areas. They coordinate incoming fish, often through middlemen, and form selling interfaces with consumers. However, there are also cases of retailers in communities or provinces who sell to retailers in urban areas. Within the retailers category there are private and collective initiatives. The former operate often as cooperative groups, either formally organized as part of a government support initiatives (e.g. fisher licensing initiatives) or locally organized.

Transactions occurred across three different scales: (i) Landing site/communities - in the immediate vicinity of the landing sites; (ii) Rural - in the broader rural environment that the landing site feeds into; and (iii) Urban - those facilitating transport of fish to urban centres (Fig. 8). The fish chains that comprise the networked trade and distribution system were highly porous, with 'fish spillage' occurring through informal (and opportunistic) trade. Trade actors drove the flow of fish, and their social networks and entrepreneurial decision-making shaped fish trade and distribution patterns. Understanding that the system is highly dynamic and responsive to trade barriers and opportunities, the schematic in Fig. 8 outlines foundational structures and connections for these fish chains. Distinction has been made between fish chains of inshore/reef species and deep-bottom/pelagic species.

While the vast majority of fish was traded through informal fish chains, a subset of trade and distribution occurred within regulated channels. This latter set of transactions were subject to coordination by cooperative establishments initiated with government support. These were often formed around solar-powered freezers that have been installed and established as fishing cooperatives, and which become part of larger networks of community-based cool storage infrastructure enabling the transfer of fish into provincial market hubs. Government initiatives supporting cool storage have been established in part to increase control of fish trade, bolster production and associated income, and improve people's access to affordable fish. Examples of active 'regulated trade' include those in the provincial centres of Sola in Torba province, Lakatoro in Malampa province and Lenakel in Tafea province. Here, consistent local market demand owed to the establishment of village fishing cooperatives, and most fish sold to the cooperatives were consumed within communities.

Most traded fish was targeted at specific consumers and occurs through established but informal market connections such as small retail shops in rural market hubs (Fig. 8). Fish delivered to urban market hubs were generally channelled into two sectors, with high value, larger deep-bottom/pelagic species sold to hotels, restaurants and retailers, while lower value, smaller inshore/reef species were sold at local produce markets and small retail outlets. Such directed flows reflect market demand and pricing. As reported by traders, tourism and hospitality establishments paid relatively higher prices compared to other retail markets.

Business relationships between traders and market retailers form particular rural-to-urban trade flows of deep-bottom/pelagic fishes. In the urban centres of Port Vila and Luganville, as well as in provincial centres, hotels and small-scale retailers regularly place orders to artisanal fishers and traders by phone when their fish stock is low. In some cases, small-scale retailers will use their extended family links to maintain a business relationship. In provincial centres like Saratamata (Penama province), Lakatoro (Malampa province) and Lenakel (Tafea province), shop owners will arrange for extended family in coastal villages and nearby islands to supply a monthly target weight of 100 kg at an average price of VUV 600/kg (USD 4.89), which can yield up to VUV 60,000 (≈USD 480) monthly. After subtracting expenses of gear, fuel, transport and labour, fishers were left with a monthly profit of VUV 30,000 (≈USD 200), which for rural areas is substantially higher than the estimated average per capita monthly income of VUV 15,500 (≈USD 120) [52].

Small-scale retailers were scattered around Port Vila and Luganville, often in suburban areas serving low to high income households. These retailers form important facilitators for traders to reach consumers. In rural market hubs, small-scale retail shops were preferred by traders over village co-operatives, largely because they tend to offer relatively higher prices and consistently buy larger volumes of fish. Furthermore, business activity in rural market hubs oscillates around ship and plane arrivals. Peaks of trade activity also occurred during government pay week. At these times, small-scale retailers capitalised on increased

[1] We use the term 'middlemen' given its prevalent use in the Vanuatu fisheries context, however we acknowledge the gender exclusionary nature of this term. Alternative framing as an 'intermediate trader' may be considered.

		CATCH	SELL TO			BUY FROM			
LEGEND: Fishers, Traders, Consumers		Fishing active	Community based	Provincial	Urban	Fisher - landing site (primary)	Trader (secondary)	Trader (tertiary)	
FISHERS	Non-motorised - 'low' capital-asset fishers: e.g. gleaners, land fishers, spear fishers								Place-based
FISHERS	Motorised - 'high' capital-asset fishers								Place-based
TRADERS / MIDDLEMEN	Middlemen-fisher								Fish transfer
TRADERS / MIDDLEMEN	Middlemen -incl. agents who don't to sell to consumers								Fish transfer
TRADERS / RETAILERS	Village retailer (private)								Place-based
TRADERS / RETAILERS	Village cooperative (collective)								Place-based
TRADERS / RETAILERS	Provincial retailer (private)								Place-based
TRADERS / RETAILERS	Provincial cooperative (collective)								Place-based
TRADERS / RETAILERS	Urban retailer - incl. stores, restaurants								Place-based

Fig. 7. Table presenting different actors (fishers and traders) active across trade and distribution networks, and their respective involvement in trading and distributing fish.

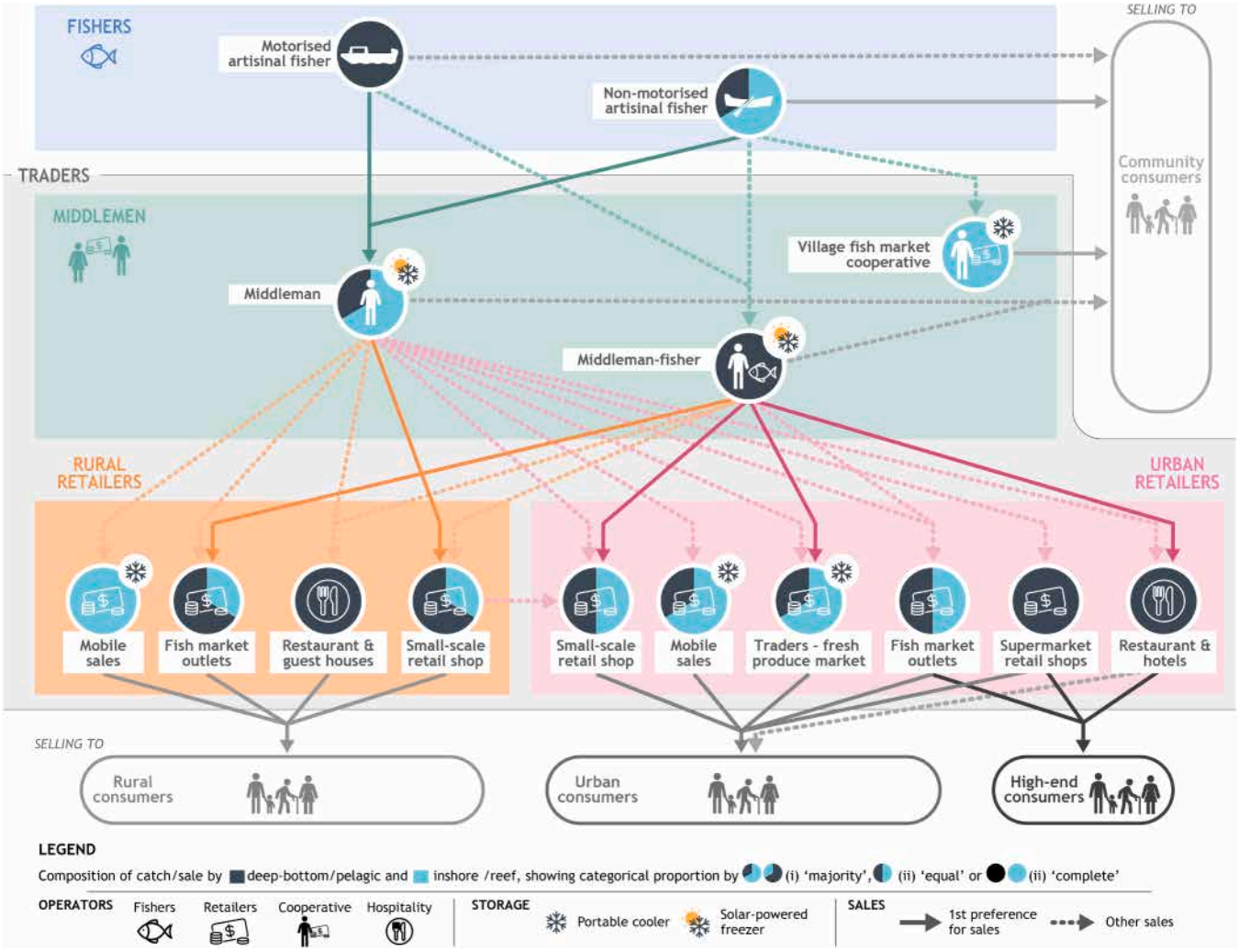

Fig. 8. Schematic diagram of structures and flows of fish by trade actors across Vanuatu's domestic trade and distribution networks.

demand to sell their supplies, both fresh and frozen.

4. Discussion

The research makes a novel and important contribution as part of achieving its objective to set a baseline understanding of domestic finfish trade and distribution in Vanuatu. It demonstrates that landings from the inshore/reef and bottom/pelagic fisheries flow through three main channels: the central trade connections between Santo and Efate island; subsidiary trade connection around Tafea provincial islands; and peripheral trade connections in the northeastern provinces (Penama and Torba). These three market systems are shaped by a range of parameters including trade actors' connectivity, population size and the physical environment.

Trade actors' connectivity: Physical linkages between fishers and market were critical because shipping services enabled much of the national domestic trade [34]. The central islands in Vanuatu were better connected, resulting in consistent supply of fish destined for rural and urban markets. Studies show how community-based fishers that have better access to distributive agents such as ships and vehicles are likely to be more consistent suppliers to extensive market locations [7]. Similarly, in Vanuatu, more frequent and extensive shipping connections are likely to significantly contribute to greater circulation of fish in the domestic market supply.

Demographics: Demand for fish is proportional to the size of a population and therefore increased fish trade. Approximately 130,000 people, live in rural areas on the big islands of Santo, Malekula, Tanna and Efate. Another 67,000 people live in the two main urban centres of Port Vila and Luganville, therefore more than two thirds of the total population is concentrated across these central islands. The intense demand of fish for food and livelihoods translates to higher community participation in the coastal fishery and trade, with significant implications to the extent of pressure on fish resources. Brewer et al., [8] documentation of impacts of fishing pressures in the Solomon Islands showed similar trends where villages closer to market sites had significantly reduced reef fish biomass.

Physical environment: Vanuatu is a tropical volcanic archipelago characterised by short fringing reef systems and steep reef slopes. Hence the inshore and reef fisheries productivity is lower than most other Pacific Island countries and territories (PICTs). The majority of inshore and reef fisheries are active around the few smaller islands that have larger reef areas such the Torres, Maskelynes, and Shepherds Islands. The deep-bottom/pelagic fishing occurs throughout the country, on seamounts and deep reefs, with production highest around the populous central islands from Santo to Tanna.

Vessels primarily distributed goods and services throughout the geographically dispersed islands. The arrival and departure of inter-coastal vessels sees heightened levels of fish trade. Coastal communities that experienced higher frequency of ship visits, trade more fish between islands. In the Maskelynes islands, two inter-island vessels have weekly stopovers on their voyage between Port Vila and Luganville. Traders in Port Vila send ice in coolers to relatives or business partners, who have a day to purchase fish from artisanal fishers, load coolers with reef, deep-bottom and pelagic fishes, and ship them on to Port Vila. Similar trade activity occurs in Epi and the Shepherds Islands (Tongoa, Tongariki, Buninga, Emae, Makira, and Mataso), where ship visits are frequent. In contrast, islands such as Ambae and Maewo, and the Torba provincial islands, have lower frequency of ship visits. Here fish trade concentrates on intra-island fish trade with coastal and inland communities and sees less intense cyclical trade patterns.

This study identified that some fish traders direct trade effort on a fortnightly basis to provincial centres such as Sola in Banks and Saratamata in Ambae, and rural market hubs such as Rovo bay in Epi and Morua in Tongoa. This coincides with salary days for rural civil servants whereby the banking, post office and other services attract villagers who want to access these services and artisanal fishers, traders and farmers who want to sell catch and garden produce. In rural market contexts, artisanal fishers and traders target weekly fresh produce markets and small-scale retailers with whom they have existing business relationships. This finding is consistent with findings from international studies showing that SSF fishers target shared trading locations (i.e., market sites) [16] and engage in trading relationships with specific traders [23]. Furthermore, these trade patterns are crucial as they not only reinforce social relations between traders and fishers, but also generate income that supports household needs and community-led activities [18,35]. These tangible benefits form strong incentives to engage in, and contribute to, community-based management of coastal fisheries resources [44].

Trade activity naturally fluctuated with market demand. Cruise ship visits drive acute and extreme demand spikes, with potentially over two thousand tourists landing on island shores on any one day. Local communities and authorities, invest in offering cultural activities, handicraft sales and local catering, as evident in rural cruise ports in east Santo, south Pentecost and Aneityum. Small economies can emerge in the weeks running up to a cruise ship visit [36]. Such trade spikes are very site specific and highly predictable based on cruise ship schedules that are released on an annual basis. Fishers plan their activities in line with cruise ship visits, through increased fishing effort in the days leading up to visits. Traders primarily supply deep-bottom/pelagic fish to food stalls for tourists. Smaller reef fishes tend not to be sold to tourists, in part because smaller bony fish are less preferred and because some species like reef groupers (*Plectropomus laevis*) and snappers (*Lutjanus bohar*) are susceptible to ciguatera contamination (*Gambierdiscus toxicus*) which can cause fish poisoning [24]. While there are reports of ciguatera poisoning in different villages, particularly after disaster events [39,45], there is limited information on ciguatera fish poisoning among tourists in Vanuatu. This may be in part due to absence of systematic monitoring and/or due to active information and awareness campaigns geared towards tourists. Examples from other regions like the Caribbean show an explicit high demand of grouper and snapper species for consumption by tourists [25], which may suggest there is higher contamination risk as tourism in Vanuatu rebounds after impacts of COVID-19.

Intra-island trade tended to consist mainly of inshore/reef fishes traded at the rural market, whereas the inter-island trade tends to be dominated by deep-bottom/pelagic fishes that are traded out to the urban market. This is with exception of a few specific market connections that drive exceptionally high trade of inshore/reef fishes to Port Vila and Luganville. Reef fishing is allowed in the coastal areas within a village's boundaries, with the exception of demarcated managed areas (which may take the form of local marine reserves or *tabu* areas, managed by communities under a variety of rules) where access is controlled. Moreover, with reefs generally being near shore, production of reef fish is relatively consistent throughout the year. Besides fringing reef systems, the many inter-tidal reef systems not only enable quick access by different types of fishers—including men, women and youths—but also allow for simple gear such as handlines and spearguns to be effective [9]. During low tides, for example, villagers congregate on reef flats to fish and glean for marine invertebrates, for both consumption and trade.

Many non-motorised artisanal fishers and traders were asset-poor, so close proximity to the market is as important as easy access to close fishing grounds. For example, canoe fishers in Waisisi village in east Tanna, in Tafea province, catch fish daily to sell to inland communities and farmers who commute through their village on their way to and from Lenakel provincial centre. On the remote island of Futuna, in the same province, the demand for reef fish is sufficiently high that all reef fish caught is consumed locally. To foster this, communities have partnered with national stakeholders to establish fishing cooperatives in four of the main villages that buy, store and sell fish. This village enterprise encourages artisanal fishing but also mitigates their remoteness (which inhibits trade to the outside) and frees time for households to attend other livelihood activities such as gardening or small livestock rearing.

There are, however, specific supply chains which exhibited

differences in flows, such as the Maskelynes Islands group, in Malampa province (See Fig. 5). This small group of islands ships by far the highest count of reef fishes to Port Vila urban area. This is explained by the area's extensive fishing grounds in combination with being the most frequented by shipping services in the country. The demand in Port Vila is likely driven by preference for fresh fish among urban residents, as substitutes to other protein sources like chicken, or more expense beef options.

As a general characteristic, reef/inshore are cheaper and perceived more convenient, particularly in (rural) contexts where storage is an issue. This is in part a consequence of their general fish size being smaller, translating to lower absolute costs but also because there is no need to take preservation measures as fish are generally consumed in a single meal.

Trade of deep-bottom/pelagic fishes is more extensive, from rural areas to the urban markets and larger provincial centres. Involving larger fish, compared to reef fishes, the deep-bottom/pelagic fishes are fundamentally traded along routes that have cold chain infrastructure. The trade flow to urban market tends to more directed by business ties between trade actors, in addition to high market demand and overall higher value. Vanuatu's pre- and post-COVID-19 domestic economy depends largely on the tourism and hospitality sector [36]. Deep-bottom snappers are highly sought after by urban hospitality establishments and are marketed under a local term *'poulet'* (French for chicken), because when filleted the meat resembles chicken breast. Capitalising on this demand, traders target these establishments as first preference of sale.

Seasonal shifts in resource availability is also a determining factor for trade of certain species; particularly for pelagic species, which typically move around by season and by changes in ocean current movement. Flying fish trade booms at markets, for example, spike seasonally across Vanuatu, and drive particularly active trade across the islands in Tafea.

5. Conclusion

The structure of the coastal fisheries market system in Vanuatu presents a complex trade and distribution network that connects fish supply points (e.g. landing sites) with rural and urban consumers. While similarities to other PICTs were noted in the supply of fish, namely comprising of two main fisheries; inshore and reef fishery and a deep-bottom/pelagic fishery, aspects to Vanuatu's trade and distribution networks are distinct. Rural communities, although often geographically distant from the provincial and urban centres were the main suppliers, while the well-connected central island belt between Santo and Efate islands formed the main trade channel. The southern islands of Tafea province, although remote, are relatively well-connected and formed a subsidiary market hub. The eastern and northern islands showed weak connectivity and formed a peripheral hub. Consistent with studies in other countries, better connectivity corresponded in higher levels of trade [43], such that on islands with better roads networks, fish trade reached further inland. Trade patterns by fish type, indicated that the majority of inshore/reef fishes were traded at rural markets and more than half the deep-bottom/pelagic fishes produced were traded at the three main market centres; namely the two urban centres of Port Vila and Luganville, and the provincial centre of Lenakel in Tafea province.

The baseline presented here shows that the trade and distribution of finfishes in Vanuatu emerge from a networked market system that is largely self-regulated through social relations. External factors such as disaster events, the COVID-19 pandemic and socioeconomic shifts (e.g. from temporary overseas labour migration employment) explain some of this spatial and temporal variability. This understanding presents opportunities for more effective and directed rural development in coastal zones to be delivered through, for example, market improvement initiatives. Such initiatives stand to translate to livelihood impacts for fishers and traders, to ensure rural productivity meets nutrition demands, and to provide platforms where regulation of markets can contribute to improved governance over coastal fisheries.

CRediT authorship contribution statement

Pascal Dumas: Writing – review & editing, Methodology, Formal analysis, Data curation. **Dirk Steenbergen:** Writing – review & editing, Writing – original draft, Visualization, Methodology, Investigation, Funding acquisition, Formal analysis, Data curation, Conceptualization. **Neil Andrew:** Writing – review & editing, Visualization, Formal analysis, Conceptualization. **Tom Brewer:** Writing – review & editing, Methodology, Formal analysis, Data curation. **Jeremie Kaltavara:** Writing – review & editing, Writing – original draft, Visualization, Methodology, Investigation, Funding acquisition, Formal analysis, Data curation, Conceptualization.

Funding

This research was funded by the University of Wollongong through an International Postgraduate Tuition Award (IPTA) scholarship with additional support from the Australian Government through an Australian Centre for International Agricultural Research project (FIS-2020–172).

Acknowledgements

We gratefully acknowledge the fishers, traders and other fish trade actors throughout Vanuatu who participated in this study. We acknowledge the support of the Government of Vanuatu through the former Ministry of Agriculture, Livestock, Forestry, Fisheries and Biosecurity for support. We thank the Vanuatu Fisheries Department, *Tails*+ monitors and local community leaders for supporting this research and providing information. We also thank the SPC Fisheries, Aquaculture and Marine Ecosystems Division for guidance in understanding the regional *Tails* program. We thank the Department of Ports and Harbour for providing information for this research. We thank Lena Kaltavara and Eleanor McNeill for assistance with data entry and graphics respectively. We thank Dr. Cathy Hair and Dr. Anna Farmery for helpful feedback in earlier manuscript versions. This manuscript was completed as a part of a PhD thesis for JK who is funded by a University of Wollongong through an International Postgraduate Tuition Award (IPTA) scholarship with additional support from the Australian Government through an Australian Centre for International Agricultural Research project (FIS-2020–172).

Data availability

Data will be made available on request.

References

[1] N. Andrew, B. Campbell, A. Delisle, O. Li, P. Neihapi, B. Nikiari, A. Sami, D. Steenbergen, T. Uriam, Developing participatory monitoring of community fisheries in Kiribati and Vanuatu, SPC Fish. Newsl. 162 (August 2020) (2020) 32–38. ⟨http://purl.org/spc/digilib/doc/b8hvs⟩.

[2] J.D. Bell, J. Albert, G. Amos, C. Arthur, M. Blanc, D. Bromhead, S.F. Heron, A. J. Hobday, A. Hunt, D. Itano, P.A.S. James, P. Lehodey, G. Liu, S. Nicol, J. Potemra, G. Reygondeau, J. Rubani, J. Scutt Phillips, I. Senina, W. Sokimi, Operationalising access to oceanic fisheries resources by small-scale fishers to improve food security in the Pacific Islands, Mar. Policy 88 (February 2017) (2018) 315–322, https://doi.org/10.1016/j.marpol.2017.11.008.

[3] Bell, L., & Amos, M. (1993). Republic of Vanuatu fisheries resources profiles.

[4] C. Béné, R. Arthur, H. Norbury, E.H. Allison, M. Beveridge, S. Bush, L. Campling, W. Leschen, D. Little, D. Squires, S.H. Thilsted, M. Troell, M. Williams, Contribution of fisheries and aquaculture to food security and poverty reduction: Assessing the current evidence, World Dev. 79 (2016) 177–196, https://doi.org/10.1016/j.worlddev.2015.11.007.

[5] Berkes, F. (2001). Managing Small-scale Fisheries: Alternative Directions and Methods. International Development Research Centre (IDRC),.

[6] F. Berkes, Evolution of co-management: role of knowledge generation, bridging organizations and social learning, J. Environ. Manag. 90 (5) (2009) 1692–1702, https://doi.org/10.1016/j.jenvman.2008.12.001.

[7] Brewer, T. (2011). Coral reef fish value chains in Solomon Islands: Market opportunities and market effects on fish stocks. ⟨http://www.spc.int/DigitalLibrary/Doc/FAME/Reports/Brewer_11_FishValue_SolomonIs.pdf⟩.

[8] T.D. Brewer, J.E. Cinner, A. Green, J.M. Pandolfi, Thresholds and multiple scale interaction of environment, resource use, and market proximity on reef fishery resources in the Solomon Islands, Biol. Conserv. 142 (8) (2009) 1797–1807, https://doi.org/10.1016/j.biocon.2009.03.021.

[9] B. Campbell, D. Steenbergen, O. Li, A. Sami, B. Nikiari, A. Delisle, P. Neihapi, T. Uriam, N. Andrew, Characterising a diversity of coastal community fisheries in Kiribati and Vanuatu, Fish Fish 25 (5) (2024) 837–857, https://doi.org/10.1111/faf.12849.

[10] E. Cillaurren, G. David, R. Grandperrin, Coastal Fisheries Atlas of Vanuatu: A 10-year Development Assessment, Institut de recherche pour le développement (IRD, 2001.

[11] P.J. Cohen, D.J. Steenbergen, Social dimensions of local fisheries co-management in the coral triangle, Environ. Conserv. 42 (3) (2015) 278–288, https://doi.org/10.1017/S0376892914000423.

[12] E. Coronado, S. Salas, M.F. Cepeda-González, R. Chuenpagdee, Who's who in the value chain for the Mexican octopus fishery: Mapping the production chain, Mar. Policy 118 (ember 2019) (2020), https://doi.org/10.1016/j.marpol.2020.104013.

[13] R. Dacks, S.A. Lewis, A.S. James, L.L. Marino, K.L.L. Oleson, Documenting baseline value chains of Palau's nearshore and offshore fisheries prior to implementing a large-scale marine protected area, Mar. Policy 117 (March 2019) (2020) 103754, https://doi.org/10.1016/j.marpol.2019.103754.

[14] DEPC, FAO, National integrated coastal zone management framework and implementation strategy for Vanuatu: A national approach to cooperative integrated coastal management, Department of Environmental Protection and Conservation, 2024.

[15] E. Drury O'Neill, B. Crona, A.J.G. Ferrer, R. Pomeroy, N.S. Jiddawi, Who benefits from seafood trade? A comparison of social and market structures in small-scale fisheries, Ecol. Soc. 23 (3) (2018) 12, https://doi.org/10.5751/ES-10331-230312.

[16] E. Drury O'Neill, T. Lindahl, T. Daw, B.I. Crona, A.J. Ferrer, R. Pomeroy, An experimental approach to exploring market responses in small-scale fishing communities, Front. Mar. Sci. 6 (JUL) (2019) 1–16, https://doi.org/10.3389/fmars.2019.00491.

[17] DSPPAC, Vanuatu 2030: The People's plan, Department of Strategic Policy, Planning and Aid Coordination, Port Vila, 2016.

[18] H. Eriksson, R. Sulu, J.L. Blythe, J. van der Ploeg, N. Andrew, Intangible links between household livelihoods and food security in Solomon Islands: implications for rural development, Ecol. Soc. 25 (4) (2020), https://doi.org/10.5751/es-11709-250418.

[19] Gillet, R. (2016). Fisheries in the economies of Pacific Island Countries and Territories. P. Community.

[20] Gillet, R., & Cartwright, I. (2010). The Future of Pacific Island Fisheries (9789820004221).

[21] R. Gillet, M. Tauati, Fisheries of the Pacific Islands regional and national information, Food and Agriculture Organization of the United Nations (FAO), 2018.

[22] R. Gillett, M. Fong, Fisheries In the Economies of Pacific Island Countries and Territories (Benefish Study 4), Pac. Community (2023), https://doi.org/10.4000/books.pacific.395.

[23] B. González-Mon, Ö. Bodin, B. Crona, M. Nenadovic, X. Basurto, Small-scale fish buyers' trade networks reveal diverse actor types and differential adaptive capacities, -106338, Ecol. Econ. 164 (August 2018) (2019) 106338, https://doi.org/10.1016/j.ecolecon.2019.05.018.

[24] A. Goodman, T.N. Williams, K. Maitland, Ciguatera poisoning in Vanuatu, Am. J. Trop. Med. Hyg. 68 (2) (2003) 263–266.

[25] Hackshaw, L. (2015). Evaluating and developing a market-driven value chain that provides high quality fresh fish products for the local Market in Antigua and Barbuda United Nations University Fisheries Training Programme,]. Iceland. ⟨https://crfm.int/~uwohxjxf/images/Larique_Hackshaw_Thesis.pdf⟩.

[26] F.R. Hickey, R.E. Johannes, Recent evolution of village-based marine resource management in Vanuatu, SPC Tradit. Mar. Resour. Manag. Knowl. Inf. Bull. 14 (2002) 8–21.

[27] A. Hunt, 20,000th tails logsheet uploaded, SPC Fish. Newsl. 157 (2018) 8.

[28] M. Inácio, K. Mikša, M. Kalinauskas, P. Pereira, Mapping wild seafood potential, supply, flow and demand in Lithuania, Sci. Total Environ. 718 (2020), https://doi.org/10.1016/j.scitotenv.2020.137356.

[29] A.S. Jueseah, O. Knutsson, D.M. Kristofersson, T. Tómasson, Seasonal flows of economic benefits in small-scale fisheries in Liberia: A value chain analysis, Mar. Policy 119 (2020), https://doi.org/10.1016/j.marpol.2020.104042.

[30] J.N. Kittinger, L.T. Teneva, H. Koike, K.A. Stamoulis, D.S. Kittinger, K.L.L. Oleson, E. Conklin, M. Gomes, B. Wilcox, A.M. Friedlander, From reef to table: Social and ecological factors affecting coral reef fisheries, artisanal seafood supply chains, and seafood security, PLoS One 10 (8) (2015) e0123856, https://doi.org/10.1371/journal.pone.0123856.

[31] Kronen, M., Stacey, N., Holland, P., Magron, F., & Power, M. (2007). Socioeconomic fisheries surveys in Pacific Islands: A manual for the collection of a minimum dataset.

[32] M. Léopold, G. David, J. Kaltavara, J. Raubani, D. Zeller, L. Hood, An improved reconstruction of total marine fisheries catches for the New Hebrides and the Republic of Vanuatu: 1950 – 2014, Front. Mar. Sci. 4 (2017) 306, https://doi.org/10.3389/fmars.2017.00306.

[33] V.T.T. Loc, S.R. Bush, L.X. Sinh, N.T. Khiem, High and low value fish chains in the Mekong Delta: Challenges for livelihoods and governance, Environ. Dev. Sustain. 12 (2010) 889–908, https://doi.org/10.1007/s10668-010-9230-3.

[34] MIPU, VAN: Interisland shipping support project: Port Vila, Ministry of Infrastructure and Public Utilities, 2011.

[35] M.A. Moreau, C.J. Garaway, Trading fast and slow: Fish marketing networks provide flexible livelihood opportunities on an East African floodplain, Front. Sustain. Food Syst. 5 (September) (2021) 1–20, https://doi.org/10.3389/fsufs.2021.742803.

[36] Movono, A., Neihapi, P.T., Regina, S., & Steenbergen, D.J. (2021). The agency of local people in the Pacific: indigenous responses to the global pandemic. Retrieved 12 February 2022 from ⟨https://devpolicy.org/pacific-indigenous-responses-to-the-global-pandemic-20211125/⟩.

[37] D.A. Nolin, Food-sharing networks in Lamalera, Indonesia: Reciprocity, kinship, and distance, Hum. Nat. 21 (3) (2010) 243–268, https://doi.org/10.1007/s12110-010-9091-3.

[38] M.R. Poe, P.S. Levin, N. Tolimieri, K. Norman, Subsistence fishing in a 21st century capitalist society: From commodity to gift, Ecol. Econ. 116 (2015) 241–250, https://doi.org/10.1016/j.ecolecon.2015.05.003.

[39] A. Rarai, E. Weber, J. Ruben, M. Parsons, Indigenous knowledge with science forms an early warning system for ciguatera fish poisoning outbreak in Vanuatu, Commun. Earth Environ. 5 (1) (2024), https://doi.org/10.1038/s43247-024-01931-5.

[40] J. Raubani, H. Eriksson, P.T. Neihapi, R.T. Baereleo, M. Amos, K. Pakoa, S. Gereva, G. Nimoho, N. Andrew, Past experiences and the refinement of Vanuatu's model for supporting community-based fisheries management, SPC Tradit. Mar. Resour. Manag. Knowl. Inf. Bull. 38 (2017) 3–13.

[41] M.C. Rodman, Constraining capitalism? Contradictions of self-reliance in Vanuatu fisheries development, Am. Ethnol. 14 (1987) 712–726, https://doi.org/10.1525/ae.1987.14.4.02a00070.

[42] M.B. Roscher, H. Eriksson, M. Sharp, O. Menaouer, N. Andrew, Decadal characteristics of small-scale fishing livelihoods in 13 Pacific Island Countries and Territories, ICES Journal Marine Science(July) (2023) 1–13, https://doi.org/10.1093/icesjms/fsad125.

[43] D.J. Steenbergen, H. Eriksson, K. Hunnam, D.J. Mills, N. Stacey, Following the fish inland: understanding fish distribution networks for rural development and nutrition security, Food Secur. (2019), https://doi.org/10.1007/s12571-019-00982-3.

[44] D.J. Steenbergen, M. Fabinyi, K. Barclay, A.M. Song, P.J. Cohen, H. Eriksson, D. J. Mills, Governance interactions in small-scale fisheries market chains: Examples from the Asia-Pacific, -faf.12370, Fish. Fish. (May) (2019) faf.12370, https://doi.org/10.1111/faf.12370.

[45] D.J. Steenbergen, P.T. Neihapi, D. Koran, A. Sami, V. Malverus, R. Ephraim, N. Andrew, COVID-19 restrictions amidst cyclones and volcanoes: A rapid assessment of early impacts on livelihoods and food security in coastal communities in Vanuatu, Mar. Policy 121 (August) (2020), https://doi.org/10.1016/j.marpol.2020.104199.

[46] D.J. Steenbergen, A.M. Song, N. Andrew, A theory of scaling for community-based fisheries management, Ambio 51 (2021) 666–677, https://doi.org/10.1007/s13280-021-01563-5.

[47] M. Thyresson, B. Crona, M. Nyström, M. de la Torre-Castro, N. Jiddawi, Tracing value chains to understand effects of trade on coral reef fish in Zanzibar, Tanzania, Mar. Policy 38 (2013) 246–256, https://doi.org/10.1016/j.marpol.2012.05.041.

[48] VFD, Vanuatu National Deep-Bottom Fish Fishery Management Plan, Secretariat of the Pacific Community, Port Vila, Vanuatu, 2016.

[49] VFD, *Vanuatu National Roadmap for Coastal Fisheries: 2019 – 2030.* (9789820012066, Secretariat of the Pacific Community, Noumea, New Caledonia, 2019.

[50] VFD. (2019b). What is tails? Vanuatu Fisheries Department (VFD). ⟨https://fisheries.gov.vu/what-we-do/projects/tails-projects-sites⟩.

[51] VNSO. (2007). Census of Agriculture 2007 Port Vila, Vanuatu: Vanuatu National Statistics Office Retrieved from ⟨http://www.phtpacific.org/sites/default/files/surveys_dev_reports/101/files/VUT_Ag-Census-2007_final-report.pdf⟩.

[52] VNSO, Household Income and Expenditure Survey (9789557020549) Vanuatu National Statistics Office Retrieved from, Port Vila, Vanuatu, 2010. ⟨http://www.statistics.gov.lk/HIES/HIES2016/HIES2016_FinalReport.pdf⟩ (9789557020549).

[53] VNSO, Vanuatu GDP Report, VNSO, Port Vila, 2017.

[54] VNSO, Food Security in Vanuatu, Vanuatu National Statistics Office, Port Vila, Vanuatu, 2020.

[55] World Economic Forum. (2022). This chart shows which countries consume the most or least fish. Retrieved 10 July 2024 from ⟨https://www.weforum.org/agenda/2022/11/chart-shows-countries-consume-fish-food-security/⟩.

[56] R.K. Yin. Case Study Research and Applications: Design and Methods, 6 ed., Sage, 2018.

[57] Zelasney, J., Ford, A., Westlund, L., Ward, A., & Riego Peñarubia, O. (2020). Securing sustainable small-scale fisheries: Showcasing applied practices in value chains, post-harvest operations and trade (925132350X). (FAO Fisheries and Aquaculture Technical Paper, Issue.