Blue Communities Project 5: Capturing the socio-economic benefits of handline and pole-and-line tuna fisheries in Indonesia

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I. Glossary

Catch Share System - A term used to describe a payment system. Fishermen are not salaried employees, and instead share in the revenue or profits generated by the crew as whole. When a catch share system is in place the income of fishermen varies according to fish catch and the average price received for the fish.

Crew - This refers to crew and skipper and any other people (cook, mechanic etc) consistently working on a vessel.

Exclusive Economic Zone (EEZ) - An Exclusive Economic Zone (EEZ) is a concept adopted at the Third United Nations Conference on the Law of the Sea (1982), whereby a coastal State assumes jurisdiction over the exploration and exploitation of marine resources in its adjacent section of the continental shelf, taken to be a band extending 200 miles from the shore.

Fisheries Management areas (WPP) - Established by the Fisheries Law No 33/ 2004 which has been revised by Law No 45/ 2009, WPP is identified as a management area for fishing, aquaculture, conservation, research and fisheries development which includes, archipelago waters, territorial seas, additional zones, and Indonesia's exclusive economic zone.

Fishers - These are individuals who operate the fishing gear on the boat to make harvests

Handline (HL) - Techniques vary, however, typically an individual will deploy a single hook and line from a stationary vessel. Once the fish bites, the fisher will haul it onto the vessel where it is put on ice to maintain freshness.

Illegal, unreported and unregulated (IUU) fishing - Illegal, unreported, and unregulated fishing activities violate both national and international fishing regulations. IUU fishing is a global problem that threatens ocean ecosystems and sustainable fisheries.

Pole-and-line (PL) - Techniques vary across regions, however generally fishers will throw live baitfish and spray water onto the surface to attract tuna schools - this is known as chumming. Multiple fishers will gather on the deck of a stationary vessel and use a single pole, line, and barbless hook to haul the fish onto the vessel. The barbless hook allows for quick release so that the hook can be returned to the sea quickly.

Skipper - This is the captain of a ship or boat, responsible for vessel operation and crew safety.

The Ministry of Marine Affairs and Fisheries (MMAF) - The Ministry of Marine Affairs and Fisheries is a government ministry that organises marine affairs and fisheries within the Indonesian government

Transshipment - The offloading of catch from a fishing vessel to a refrigerated vessel, or an iced vessel in the instance of Indonesia, far from port.

United Nations Convention on the Law of the Sea (UNCLOS) - The United Nations Convention on the Law of the Sea (UNCLOS), also called the Law of the Sea Convention or the Law of the Sea Treaty, is an international agreement that establishes a legal framework for all marine and maritime activities.

I. Acronyms

EEZ - Exclusive Economic Zone

GAV - Gross Added Value.

HL - Handline

IUU - Illegal, Unreported, and Unregulated fishing

MMAF - The Ministry of Marine Affairs and Fisheries

PL - Pole-and-line

SKJ- Skipjack tuna

VCA - Value chain analysis

WCPFC – Western and Central Pacific Fisheries Commission

YFT- Yellowfin tuna

UNCLOS - The United Nations Convention on the Law of the Sea

1.Introduction

1.1 From Wealth-based to Welfare-based Fishery Management

Across the globe, small-scale fisheries are increasingly politically and economically marginalised, with governance policies being dominated by the needs of large-scale or industrial fisheries (Kolding et al. 2014, Schuhbauer and Sumaila 2016). Effectively integrating the needs of small-scale fisheries within management policies therefore remains an important challenge facing national governments given that approximately 22 million fishers and over 90% of all vessels globally are considered to be small-scale (Schuhbauer and Sumaila 2016). This type of integration is vital for tuna fisheries in particular, as small-scale tuna fisheries provide essential support to coastal and fishing communities around the world and have the potential to be a key source of food for developing countries (Barclay 2012, Dueri et al. 2016, Bell et al. 2015).

Conversely, tuna fisheries across the globe are often managed as a wealth-based fishery, with tuna predominately harvested by industrial, government licensed fleets (McClean et al. 2019). Wealth-based management means the performance indicators of a fishery are focussed on resource rent and resource value, with the main objective being the maximisation of profit from the fishing fleet (Bene et al. 2009, Cunningham et al. 2009, McClean et al. 2019). Meanwhile, a welfare-based management approach proposes to be more appropriate for integrating the needs of small-scale fisheries, as it considers a range of social and economic benefits which are important to coastal communities beyond focusing solely on profit and resource rents (Bene et al. 2010, McClean et al. 2019).

Due to the complex nature of tuna fishery value chains, both wealth-based and welfare-based policies may be appropriate at different stages of economic and national development (Nunan 2014, Ratner and Allison 2012, McClean et al. 2019). In order to understand when a welfare-based approach would be more appropriate, it is first important to understand, quantify and be able to track the social and economic benefits of a fishery. Whilst the global profile for tuna fisheries may focus on reducing resource rents for foreign fleets, many countries benefiting from internationally shared tuna stocks are shifting more attention to local social and economic development where welfare-based management is more appropriate - one such country is Indonesia (Barclay and Cartwright 2008, Havice and Campling 2013, Havice and Reed 2012, McClean et al. 2019).

Such an approach is particularly pertinent in Indonesia as the country's small-scale fisheries account for 90-95% of national fisheries production, and the sector is essential for providing food security, direct employment and generating export revenue (Ariansyach 2017, FAO 2014, FAO 2018, Warren and Steenbergen 2021). Despite the importance of fisheries to coastal

livelihoods, approximately 7.87 million fishers in Indonesia are still living below the national poverty line, with many dependent on fishing for both food security and income (Adhuri et al. 2016; Surhano et al. 2018). This dependence on fishing for employment and food security makes it imperative that the sustainable management of resources duly considers, maintains and protects the welfare of fishers (Adhuri et al. 2016, PSHK et al. 2019).

1.2 Management of small-scale tuna fisheries in Indonesia

The Ministry of Marine Affairs and Fisheries (MMAF) is the main government institution responsible for managing the national fisheries sector (PSHK 2019). Indonesia's national waters are divided into 11 Fisheries Management areas (WPP) in order to better manage and implement monitoring, stock assessments, licensing, and total allowable catch measurements (Figure 1) (Sunoko and Juang 2014, Khan 2019). For the first 40 years after gaining independence, marine policies in Indonesia were principally focused on securing territorial waters (Aziz 2019). In 1982, after the establishment of the United Nations Convention on the Law of the Sea (UNCLOS), the government's focus shifted to the utilisation of fisheries within the EEZ, helping secure coastal livelihoods throughout the country (Aziz 2019, McClean et al. 2019). Law No. 27/2007 preserved coastal areas as national resources to be managed for the main benefit of the people - marking a significant shift asserting its sovereign rights in its EEZ to its territorial waters (Aziz 2019). Along with the 1945 constitution, there are several laws which are particularly important with regards to the fisheries sector, all of which were enacted between 2004 and 2016 (see Figure 2).

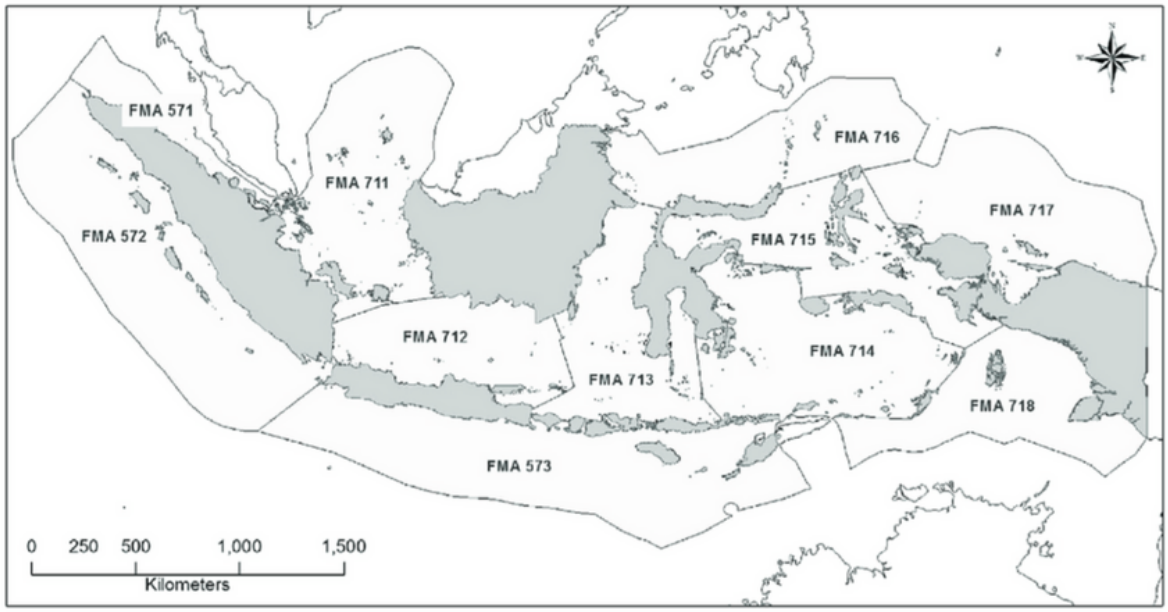

Figure 1. The Indonesian Archipelago is sub-sectioned into Fisheries Management Areas (WPPs) (Source: Pomeroy et al.2019)

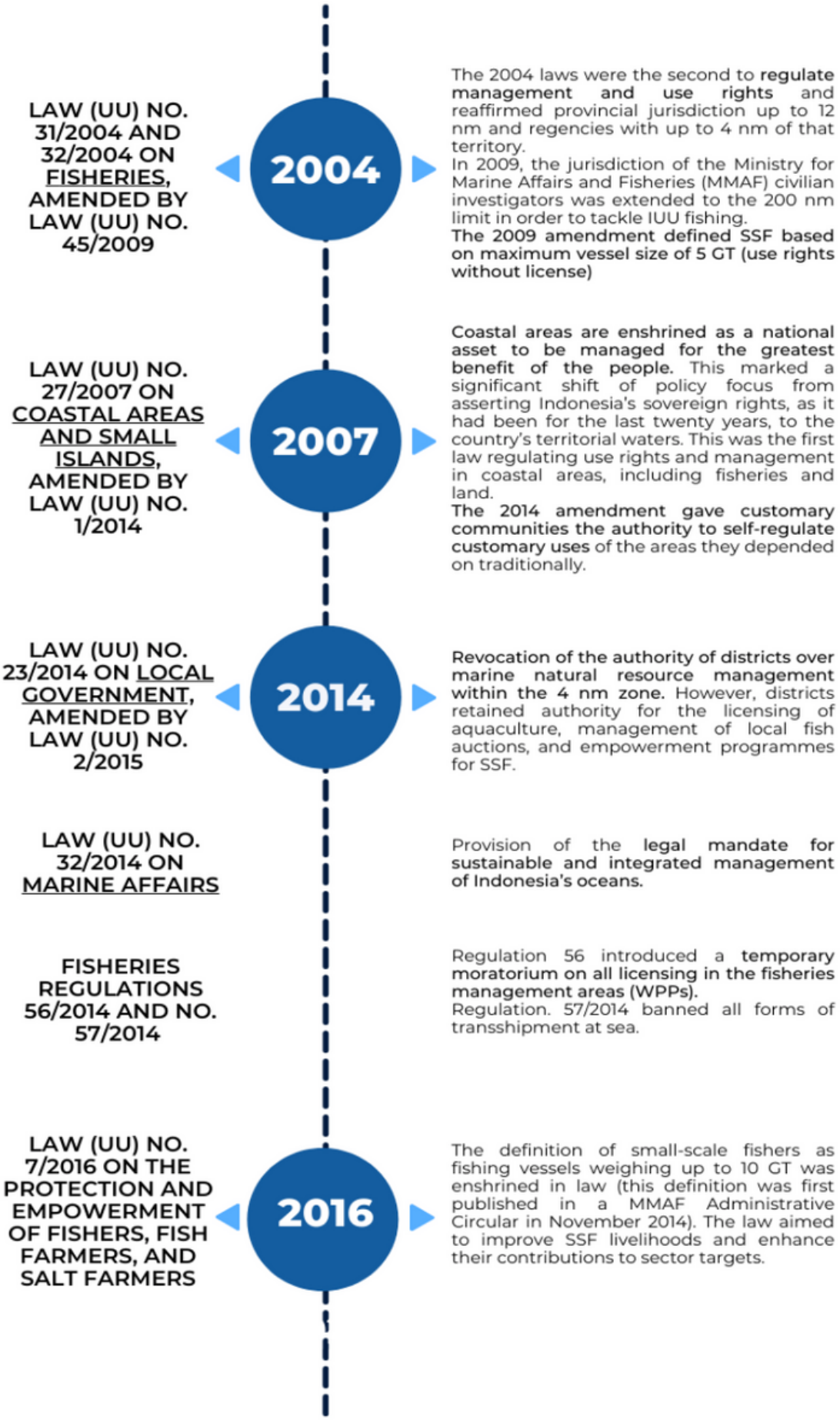

Figure 2. Indonesian Laws of particular importance to the fisheries sector (Adapted from Aziz, 2019)

Community wellbeing and the welfare of vulnerable communities represent the foundational objectives and subsequent policies of the Fisheries Management Act (2004, and its amendments in 2009), which falls under the responsibility of the current fisheries ministry. The Indonesian Government includes the wellbeing of fishers in its Fisheries Management Act, and recently stated its commitment to supporting small-scale fisheries in a letter to the Committee on Fisheries (FAO COFI) stating:

> *"... In Indonesia, [the] small-scale fisheries sector plays an important role in supporting economic and social growth... it is vital to provide necessary supports [sic] that will enable small-scale fishers to work in a sustainable manner... it is vital for all of us to translate our commitment into concrete actions that could bring real impacts toward the coastal communities and ensure sustainable future of our ocean" (Republic of Indonesia 2021).*

Despite the above statement, while some policies aiming to support welfare and wellbeing benefits have been implemented, socio-economic data is not systematically collected for fisheries in Indonesia, and so the socio-economic benefits of handline and pole-and-line fisheries are not fully understood and/or captured (McClean et al. 2019, Warren and Steenbergen 2021). A lack of understanding of socio-economic benefits, disabling their potential incorporation into future government policy, risks compromising food and livelihood security further, excluding vulnerable communities, and potentially even forcing individuals and households further into poverty (Warren and Steenbergen 2021).

1.2.1 Tuna Consortium

A lack of understanding of socio-economic benefits, disabling their potential incorporation into future government policy, risks compromising food and livelihood security further, excluding vulnerable communities, and potentially even forcing individuals and households further into poverty (Warren and Steenbergen 2021). In response to the above, the Tuna Consortium, established in 2019, is a programme consisting of seven partner organisations; MDPI, YKAN, WWF-US, SFP, EDF, Hatfield, and IPNLF. The aim of the consortium is to support the government's integration of socio-economic indicators into policy (The Nature Conservancy 2021). The goal of the Consortium is:

> *"To support the Indonesian Ministry of Marine Affairs to adopt a participatory, science-based decision-making process to implement their next 5-year tuna management plan (2019-2021) and draft Harvest Strategies for Indonesian Archipelagic Waters... supported by supply chain interventions to achieve sustainable fisheries management" (The Nature Conservancy 2021).*

The Tuna Consortium's commitment to stakeholder engagement, as well as the integration of socio-economic indicators in developing the HCRs can greatly enhance positive outcomes and potentially reduce the risk of unforeseen negative outcomes. A key characteristic of the Consortium is engagement with stakeholders in decision-making and information dissemination, including engagement on issues such as Harvest Strategies and Rules (The Nature Conservancy 2021) for Indonesian Archipelagic Waters. A Harvest Strategy determines

the assessment and monitoring of a fishery's economic and biological conditions, whilst harvest control rules (HCRs) are the operational aspect of a harvest strategy and can range from basic to multi-step strategies which control the intensity of fishing activities based on the fishery conditions (Dowling et al. 2008, Quetglas et al. 2017).

Without the required metrics, there is a risk that coastal communities may be negatively affected. Furthermore, the management strategy evaluation framework which– whilst considering statistical catch, effort, and stock trends – simulates the potential outcomes of a Harvest Strategy, may benefit from socio-economic data to understand potential social and economic impacts of a given Harvest Strategy. For this to be possible, there needs to be robust indicators which can be applied in a variety of fisheries and be used to generate large amounts of baseline data.

1.2.2 The importance of pole-and-line and handline tuna fisheries in Indonesia

Pole-and-line and handline fishing gears are both highly selective forms of fishing, with very few incidences of by-catch and no interaction with the seabed (see Figure 3), and over 100,000 tonnes of tuna are caught using handline and pole-and-line fishing methods annually in Indonesia (AP2HI 2019). Many pole-and-line and handline tuna fisheries are located in small, remote communities with limited education opportunities and poor access links due to low investment in public infrastructure (Davies et al. 2014, World Bank 2011, Lewis 2013, Duggen and Kochen 2016). Handline and pole-and-line fishing techniques are also deeply embedded in local cultures and practices and require little capital investment. Consequently, the set up costs may be quickly compensated through fishing, making these fishing opportunities a more accessible livelihood option for many coastal communities.

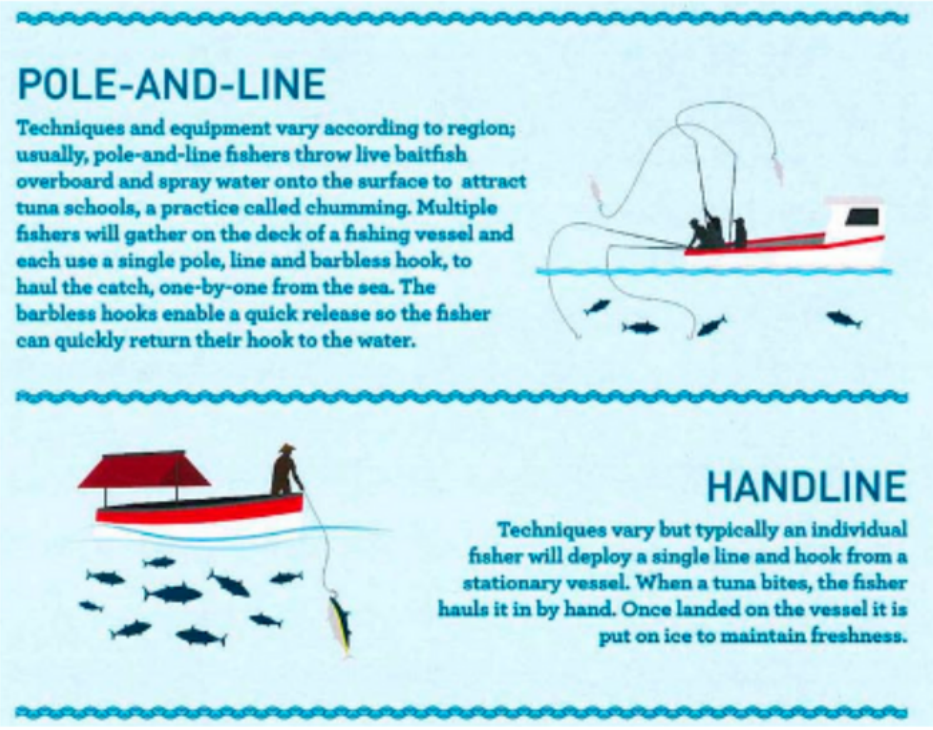

Figure 3. Infographic of handline and pole-and-line fishing techniques: Pole-and-line and handline (IPNLF 2021)

Fisheries using these types of fishing methods elicit a wide range of associated social benefits, acting as a vital source of employment and food security (Miller, 2015), and in Indonesia approximately 4,000 and 170,600 fishers are employed in the national pole-and-line and handline fisheries respectively (Bureau of Statistics Indonesia, 2016). The labour-intensive nature of handline and pole-and-line fishing means that the sectors employ many times more people per unit of harvest in comparison to industrial tuna fisheries (Miller, 2015).

The Harvest Strategy being currently developed in Indonesia has the potential to safeguard these benefits of handline and pole-and-line fisheries, but this can only be achieved if there is a robust comparable understanding of the socio-economic benefits of handline and pole-and-line fishing, (McClean et al. 2019). However, socio-economic data is not yet systematically collected for fisheries in Indonesia. As a consequence, the socio-economic benefits of handline and pole-and-line fisheries are not fully understood and/or captured within the development of the Harvest Strategy. As many Indonesian nationals are dependent on access to handline and pole-and-line fisheries, it is important to consider how the development of Harvest Strategy and Harvest Control Rules may affect them. If fisheries management policies fail to facilitate these aforementioned positive benefits of pole-and-line and handline fisheries, there is a risk that efforts to protect the ocean environment and coastal livelihoods may be undermined.

1.3 Addressing socio-economic knowledge gaps in Indonesian tuna fisheries

In response to the management challenges outlined above, this research aimed to provide insight into the potential application of indicators capturing the socio-economic contributions of the small-scale tuna fisheries sector to coastal communities in Indonesia, building directly on the framework development and overarching analysis being undertaken by researchers at the University of Technology Sydney (UTS) (Voyer et al., 2017; McClean et al. 2019). The community wellbeing framework developed by UTS provides guidance on key questions to ask when investigating the potential impacts of changes in fisheries management on the wellbeing of the associated communities (McClean et al. 2019).

There are seven topics upon which the framework is based see Table 1. This framework effectively captures both the economic and social benefits and relationships that occur throughout tuna supply chains and fisheries, as a result, this study utilised this framework to guide methodology development and selection of socio-economic indicators. However, as this study is not aimed at understanding a specific intervention, but rather at investigating the implementation of indicators quantifying socio-economic benefits in general, the topic concerning potential governance intervention was not deemed to be relevant.

Table 1. Framework for assessing fisheries governance in terms of community wellbeing, McClean et al. 2019.

Topic	Description
The potential governance intervention (not relevant to this analysis)	The intended change in a fishery, or set of options for managing a fishery or aspect of a fishery, is listed.
The fishery affected	Relevant information on gear/vessel type, target species, geographical focus, destination market or any other characteristics of the fishery that are relevant to determining the scope of the intervention are included.
Potential benefits to coastal communities	The intended or anticipated benefits that would arise from the initiative, as well as whether these are likely to be realised in the short, medium or long term. Where relevant, this should include consideration of contributions to wellbeing related to economy, food and nutritional security, and healthy environmental systems, as well as consideration of poverty alleviation and food security functions the fishery may perform.
Who in the value chain benefits?	The actors, communities or stakeholders who would receive the benefit are listed. Close consideration should be paid to socio-economic status, participation of migrant communities or migrant labour, and gender.
Potential lost benefits to coastal communities	The benefits that may be lost as a result of the intervention (such as livelihoods if catches are restricted), are listed, with likely time frame (short, medium or long-term). Where relevant, this should include consideration of contributions to wellbeing related to economy, food and nutritional security, and healthy environmental systems, as well as consideration of poverty alleviation and food security functions the fishery may perform.
Who in the value chain bears the loss/is exposed to risk?	The actors, communities or stakeholders who might lose benefits, or be exposed to risks, are listed. Close consideration should be paid to socio-economic status, participation of migrant communities or migrant labour, and gender.
Factors influencing effectiveness and the ability to mitigate risks/vulnerabilities	Any factors likely to influence the effectiveness of an initiative, or if present may mitigate the risks of an initiative, are listed. For example, the presence of alternative livelihoods, alternative food sources, or the presence of effective monitoring or management systems. This allows for realistic assessment of the feasibility of an initiative in the context of a specific fishery and management system.

With the above in mind, this report seeks to evidence application of indicators quantifying the socio-economic benefits associated with small-scale value chains using Ambon, Kendari and Bitung as case study locations, and by extension begin to address such knowledge gaps. Our work is structured around three research objectives and two corresponding questions:

Objective 1: Identify and understand the interactions and links between the various economic agents (fishers, processors, traders) in tuna fishing and trading in Ambon, Bitung, and Kendari
Objective 2: Quantitatively measure the monetary value produced along handline and pole-and-line caught tuna value chains
Research question: What are the socio-economic characteristics of small-scale tuna fisheries value chains in Bitung, Kendari and Ambon?
Objective 3: Measure and understand the distribution of socio-economic benefits derived by small-scale tuna vessel crew and skippers in Ambon, Bitung, and Kendari
Research question: What are the socio-economic benefits accrued by fishers from their fishing activities in these sites?

Combining value-chain and socio-economic approaches and measuring both monetary and non-monetary benefits of the small-scale tuna fishery is therefore key to implementing management that can change the distribution of benefits to promote improved fisher livelihoods and sustainable resource use (Purcell et al. 2017). The final goal of this work is to produce relevant outputs on socio-economic benefits associated with small-scale fishing in Indonesia that can be incorporated into future fishery management by considering the value chains and socio-economic benefits in conjunction with existing literature. In the following section, we outline the methods used to collect and analyse data and information from stakeholders in the three selected sites.

2.Materials and Methods

A combination of primary and secondary data was collected to fill the knowledge gap regarding economic and social benefits derived from small-scale fishing activities in three locations in Indonesia. Two questionnaires targeting either fishers or processors were developed with questions relevant for the VCA and socio-economic indicators analysis . The fieldwork was conducted in 2020. The collected data was analysed using the VCA method (section 2.2) and to calculate the socio-economic indicators (section 2.3).

2.1 Site Selection

This study adopted a multiple case study approach that "is particularly useful to employ when there is a need to obtain an in-depth appreciation of an issue, event or phenomenon of interest, in its natural real-life context" (Crowe et al. 2011). Handline and pole-and-line fishing is concentrated in Eastern Indonesia, and therefore the three following locations were identified: Ambon, Bitung, and Kendari (Figure 4) (AP2HI 2019). These case study sites were purposively selected as they represent the major landing centres for tropical tuna in terms of volume, while also providing a cross-section of the various fleet segments in Indonesia i.e. large and small handline and pole-and-line vessels, and of the different types of processors and downstream actors. Furthermore, the two most commercially important tuna species in small-scale fisheries (skipjack, yellowfin) are landed at these sites.

Figure 4. Map of Indonesia with the highlighting the three case study locations: Ambon (Maluku Province), Bitung (North Sulawesi Province), and Kendari (Southeast Sulawesi Province). Source: By Indonesia, administrative divisions https://commons.wikimedia.org/w/index.php?curid=12764917

Our selected study sites are located in Eastern Indonesia which is one of the most economically disadvantaged regions in the country. The region has the highest poverty rates, while economic isolation, nutritional availability, and limited services all contribute to key public health challenges (World Bank 2015). The tuna industry is recognised for playing a key role in the economic wellbeing of the region, and many policy efforts are being made to develop small-scale fisheries (Cabral et al. 2018, McClean et al. 2019). Descriptions of each study site are provided below:

2.1.1 Ambon

Ambon has three large ports and five factories. The majority of fishers here use handlines and tend to land on the beach near their homes, making it necessary for fishers to depend on middlemen to sell their catch to the few factories (Personal Correspondence 2021). There is limited electricity and few roads on Ambon, as with many remote islands around Indonesia (Duggen and Kochen 2016). As a result, there is little to no cold storage in the fisher villages, thus fishers need to sell all of their catch on the same day it has been landed.

2.1.2 Bitung

Bitung is located on the east coast of North Sulawesi and is one of the main landing sites for tuna in Indonesia, with 53 loining and canning factories for skipjack and yellowfin tuna (Bailey et al. 2016). Many of the factories are in close proximity to both the landing sites and each other, as a result there are few middlemen involved in the value chain relative to the other sites (Personal correspondence 2021). Bitung has been described as having a raw material deficiency, as there is an overcapacity at the processor level (Bailey et al. 2016, Longdong et al. 2020).

2.1.3 Kendari

Kendari is located in Southeast Sulawesi and is one of the six biggest fishing ports in Indonesia (along with Bitung) (Natsir et al. 2015). The average amount of tuna landed at the port from 2010-2014 was 20,000 tonnes, with 95% being associated with FADs. The port is a key fishing centre for over 77,000 fishers in South East Sulawesi (Directorate General of Capture Fisheries 2013). In some fishing areas, transhipment collection vessels (known as kapal angkut) and collaboration via smallholder partnership schemes are common (Natsir et al. 2015).

2.2 Questionaire Design

Two questionnaires were developed for this study, one targeting fishers (owners, skippers, and crew) and the other targeting processors (Appendix A). In a pilot study, we consulted processing companies that often collaborate with IPNLF, to ensure questions were relevant and suited for the case-study context. Once finalised, both questionnaires were uploaded in an online survey software (SmartSurvey), in English. The questionnaires were translated into Bahasa by a member of IPNLF based in Indonesia. The fisher questionnaire was developed using the Handbook for fisheries socio-demographic sample survey (Pinello et al., 2017) and a wide range of literature focused on socio-economic indicators in fisheries (Anderson et al., 2016; Van Holt et al., 2016; Voyer et al., 2017; Schuhbauer et al., 2015) (Table 2). The VCA questionnaires were formulated using examples from grey and peer-reviewed literature (Rosales, 2017; M4P, 2008; Dacks, 2020).

Table 2. Key sections of the fisher and processor questionnaires

Fisher Questionnaire	Processor Questionnaire
• Ownership and fishing effort • Costs • Income, fishing effort and destination of the first sale • Socio-demographic questions	• Description of activities • Quantity of tuna processed • Tuna purchased • Employment • Costs

2.3 Data Collection

The fieldwork took place between October-December 2020. Each interview was conducted by one or two enumerators. When internet connection was available, answers were recorded in SmartSurvey, otherwise a paper questionnaire was used and the data was later entered into SmartSurvey. Qualitative details and comments were written down and added to the "comment" sections of the questionnaire. When interviews were conducted in Bahasa, figures and quantitative data were uploaded in the English version of the questionnaire in SmartSurvey. Qualitative information was translated and uploaded in SmartSurvey at the end of the fieldwork.

In all case study locations research participants were accrued through convenience sampling by visiting various ports and landing sites in the relevant locations, and principally pertained to fishers, middlemen/suppliers and processors (Table 3). Key participants working in the processing companies were identified by in-country IPNLF staff based on their role in the company and subsequent knowledge of supply chain information required to answer the survey, thus both convenience and purposive sampling were employed. Convenience sampling identifies participants that meet certain practical criteria such as geographical proximity, availability at a given time, and willingness to participate (Dornyei 2007, Etikan et al. 2016). Purposive sampling, as used to identify processors, is the deliberate selection of individuals to participate due to certain qualities (Etikan et al. 2016) - in this case their knowledge of processing and having authority to provide information, however, there were still instances where the participant was not able to answer all questions. Both convenience and purposive sampling are known as nonprobability sampling and are applicable to qualitative and quantitative studies, however convenience sampling emphasises generalisability whilst purposive sampling emphasises obtaining a comprehensive understanding (Mile and Huberman 1994, Etikan et al. 2016).

In total, 78 stakeholders were interviewed (n = 26, 31, and 21 in Ambon, Bitung and Kendari respectively). The majority of stakeholders interviewed in Bitung and Kendari were crew members (48 % and 38 % respectively), whilst the majority of stakeholders interviewed in Ambon were skippers and owners (38 %). Overall, the majority of participants were crew members (32 %), followed by processors (27 %), skippers (22 %), and owners (22 %) - two owners in Ambon also identified as skippers. It is important to note here that the aim of the study was to test the applicability of socio-economic indicators and not necessarily to provide a representative view of the handline and pole-and-line fisheries in Indonesia. Furthermore, the sample size was greatly reduced by the Covid-19 pandemic.

Table 3. Number of and gear used by respondents per site

Respondents (n=78)	Number of respondents in each site		
	Ambon (n = 26)	Bitung (n = 31)	Kendari (n = 21)
Handline (n=40)	16	11	13
Pole-and-line (n=17)	4	9	4
Processors (n = 21)	6	11	4

2.4 Data Analysis

2.4.1Value Chain Analysis

A value chain analysis (VCA) approach was used in the context of this study to document how the monetary costs and benefits associated with the production of tuna across the case studies were distributed throughout the value chain. This approach also provided the context for this study to investigate the distribution of socio-economic costs and benefits between nodes and interactions within the fisheries. Comprehensive and up-to-date data is needed to support the optimal management of any tuna fishery, and to inform policy-makers about the conditions, constraints, and opportunities of the sector (Rosales et al. 2017, Pomeroy 2013). As such, a VCA was used for this study as it:

- Maps activities at various stages of production;
- Systematically documents economic agents and their role in the production of a given commodity; and
- Determines the distribution of benefits and existing inequalities.

The VCA conducted for this study used data from both the fishers and processors survey, representing the flow of goods amongst the different economic agents. The following calculations were carried out to estimate the annual production and value disaggregated by species and gear:

Average annual production (kg) = Average volume per trip X Average number of trips per year

Average value of species caught by gear (USD) = Average quantity sold per trip X Average price per kg

Estimated average annual value of species caught by gear (USD) = average value of species caught by gear X number of trips per year

If multiple respondents from the same fishing vessel were interviewed and reported different values, an average was used for the calculations. Values were converted from Indonesian currency to US Dollars using the rate provided by the European Commission at the time of data collection. Thus, the following exchange rates (from June 2019) were used: 1 IDR = 0.00007 USD; 1 USD = 14375 IDR.

2.4.2 Socio-economic Indicator Analysis

Whilst a VCA can relate the amount of tuna caught with a value, and subsequently show how the value is distributed throughout the value chain; the addition of socio-economic indicators in this study contributes to a more holistic understanding of the system by investigating the non-monetary benefits of fishing as well as some of the community-based impacts of the income generated through fishing.

Over 60 socio-economic indicators were identified through a literature review in order to gain a more accurate understanding of the costs and benefits of small-scale tuna fishing in Indonesia. Four themes were identified for this study: poverty alleviation, income security, food security, and local employment. The themes were determined based on the literature review, as well as an understanding of the poverty, employment, and public health policies being developed in Indonesia. The final indicators that were selected were drawn from the World Bank Fisheries Performance Indicators (Anderson et al. 2016), the Social Wellbeing in Fisheries Tool (Van Holt et al. 2016), the University of Technology Sydney (UTS) Community Wellbeing Indicators (Voyer et al 2017), and the Economic Viability Framework (Schuhbauer, Sumaila, and Chuenpagdee 2015). Within the four broad socio-economic themes 10 indicators were assessed in total (see Table 4).

Fisher income was the only metric that needed to be calculated before it could be used to assess indicators (see Table 4). Additional information regarding the national poverty line, average annual regional rural income, and annual national and regional fish consumption was required. In each instance the statistic that was relevant to the time of data capture was used, if this was not possible the information from the closest time to data capture was used - this was the case for national fish consumption when the most recent statistic was from 2017. All secondary information was captured either from the official Indonesian Government Statistical Department (Badan Pusat Statistik) or peer-reviewed journals.

Table 4. Socio-economic themes, indicators, metrics, calculation of metric, and significance

Socio-Economic Theme	Socio-economic Indicator	Metric(s) in Survey	Calculation of metric	Explanation/Significance
Poverty Alleviation	Percentage of participants in the fishery who earn above or below the relative national poverty line each month	Income of fisher National poverty line in 2020: USD 30.65 per month (Badan Pusat Statistik 2021)	Average earnings per fishing trip were multiplied by the average number of trips made per year, this gave the average earnings per year from which the average earning per month was derived. This income amount was utilised for all indicators which depended on income.	This indicator reflects the effect of income derived from the fishery on poverty alleviation. If the income from the fishery does not fall above the relative poverty line then this would make the fisher dependent on other sources of income or other members of their household. As such this indicator shows a bare minimum level of income derived from the fishery for individual subsistence.
	Percentage of participants in the fishery who earn below or above the regional rural monthly income	Income of fisher	See calculation for "Percentage of participants in the fishery who earn above or below the relative national poverty line each month. Average regional monthly earnings (rural) in 2020 (CIEC Data 2021): • Ambon - USD 158.90 • Bitung - USD 180.08 • Kendari - USD 159.42	This is a measure of the type of agents who are attracted to this fishery and become the harvesting crew. Scaling earnings by average regional earnings reflects whether the fishery is doing well at wealth generation relative to local standards.
Income Security	Percentage of harvesters who have the choice to sell to whomever they wish without	-	Participants were asked if they were able to sell to anyone they wanted or if they were contractually obliged to sell to certain businesses. This metric was intended to capture how many different options fishers had, however participants were only	Being locked into one buyer relationship may lead to unfair lending practices and other exploitation by intermediaries leaving harvesters more vulnerable to cope with additional challenges. It reflects the structure of the fishery i.e if there are few processors, if there are many

	retribution.		comfortable providing “yes” or “no” answers.	middlemen, if fishers are contracted to sell to one supplier.
	Reliable payment systems.	Difference between crew and owner/skipper knowledge of payment system on the same vessel	Vessels with two or more participants were identified. First, the alignment of answers regarding the distribution of pay between crew members with different roles was determined. Where possible, values were converted to allow for comparison as some provided answers in percentages and others with a point system. The number of individuals in each role were provided. This was used to calculate the total number of points or money that would have been received after each trip. This was then used to calculate the percentage share per role per individual.	Where payment-share systems are in place, crew members and vessel owners can evidence a shared understanding of these. This indicator captures the discrepancy between understanding of payment systems that are in place. The more aligned the understandings are the better the practice. It displays that the payment systems are transparent and well understood by all parties.
	Average fisher income as a percentage of total catch value per vessel minus costs (accounts for the equitable dynamic of	Catch share % of crew (or fixed income/value of vessel catch if applicable)	The average income of the fisher (see above) was calculated as a percentage of the average volume of that fish species caught per trip multiplied by the normal price paid per kg of that fish species (values provided by the participants were used)	Productive fisheries with catch share systems can help generate a large amount of income for fishers in comparison to working as a crew member in other fisheries. If fishers receive a larger share of the value of the catch this is a more equitable distribution of money and keeps more money in the local economy in cases where the crew are also all local. Small-scale fishers can derive more value from less catch. This implies more money proportionally going to the more traditionally

	catch share systems)			vulnerable members of the supply chain.
Food Security	Percentage of tuna catch provided to export markets vs local domestic markets.	Volumes of tuna within the value chain (proportion that goes through exporters vs what stays in domestic markets)		This displays the role of the fishery in supplying food directly to the domestic market contributing to local food security. This is preferable for a fishery contributing premium tuna products as a concern is that fishing for premium products can remove healthy seafood consumption for national residents.
	Regional annual fish consumption per capita/national fish consumption per capita (47.37 kg)	Secondary data/census information (Firmansyah et al. 2019)	National average annual fish consumption per capita - 47.37 kg (Firmansyah et al. 2019) Annual fish consumption per capita by region (Badan Pusat Statistik 2021): • Maluku (Ambon) - 60.91 kg • Sulawesi Utara (Bitung) - 58.81 kg • Sulawesi Tenggara (Kendari) - 60.24 kg	This is the amount of tuna per capita being eaten in the relevant region that the fishery operates within over the year. This is an effective indicator of the reliance of locally landed tuna in the region for food security. I.e. In areas with lower per capita consumption rates there would be less of an impact on food security if less tuna were landed.
Local Employment	Non-resident employment of crew	Proportion of crew that are residents of the province they fish in	-	This indicator provides an effective snapshot of the economic contribution of the industry to the local economy through income generation in the harvesting sector. A large portion of non-resident harvesters reflects that much of the harvesting wealth will be leaving the

				region/country, failing to boost the local economy.
	Industry retention of local crew	Average number of years working in fishery	-	This indicator is a good reflection of the historical contribution of the industry to local income generation. Moreover, the rate at which the crew force turns over in the fishery reflects wealth accumulation to crew because a crew member will only stay in the fishery if the wage is comparable to, or better than, other jobs he could obtain. Crew longevity also often means their earnings likely stay in the community and are spent locally, rather than being sent away by itinerant or immigrant crews. Third, experienced crew develop specialized knowledge and refined skills that make harvesting more efficient, so the fishery is better able to reach its wealth-generating potential.
	Fishery workforce viable for future generations	Average age of fishers	-	New fishers entering the fishery demonstrates a healthy state of the sector as it represents a desirable source of employment in comparison to alternative careers. If this sub-indicator scores highly alongside the other two then it is an effective indicator for inferring the future contribution to the local economy through sustained future income generation.

3. Results

3.1 Characteristics of Handline and Pole-and-line Tuna Value Chains

Tuna value chains in Indonesia are often long and complex, with multiple vessels, middlemen, processors, distributors, and exporters (Duggen and Kochen 2016, Karningsih et al. 2018) – a simplified version can be seen in Figure 5. Handline and Pole-and-line fishers will capture the tuna: skipjack, yellowfin, bigeye (Thunnus obesus) and in some cases neritic tunas which is not the target species and so will often be taken home for their own consumption or sold in domestic markets (Sunoko and Huang 2014, Kahn 2019). Many fishers are often associated with anchored Fish Aggregating Devices (a-FADs) which work to attract tuna, particularly skipjack and yellowfin (Wang et al. 2014, Pham et al. 2019) with the catch then often sold to a "middleman" in whole form.

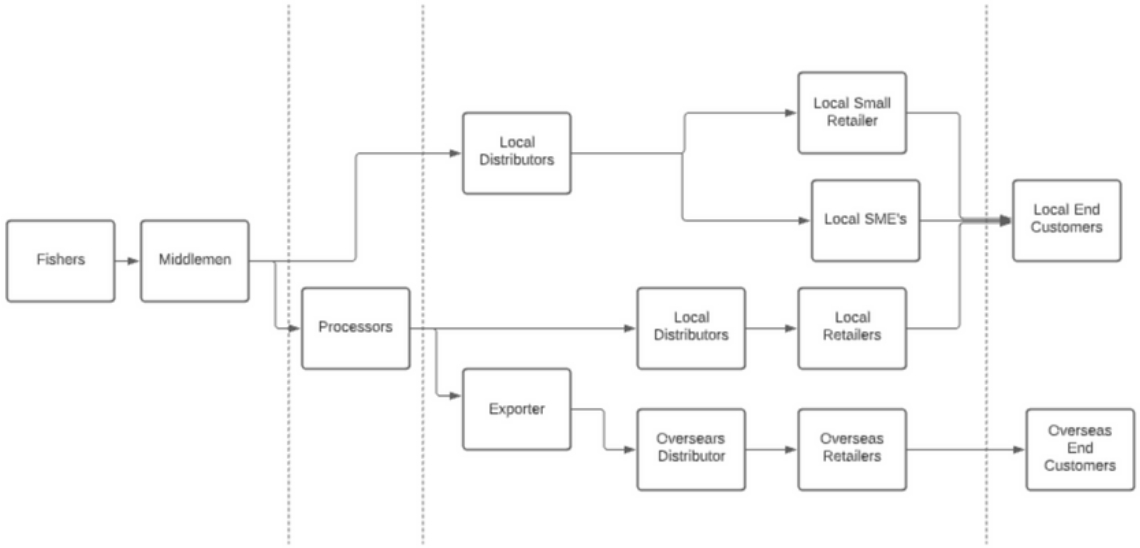

Figure 5. Simplified Indonesian tuna fishery value chain (Karningshi et al. 2018).

Middlemen perform a range of functions within the value chain, including the selling of fish to processors and other markets, as well as sometimes grading or processing the fish themselves thus securing both the volume and quality of the catch (Crona et al. 2010, Arya et al. 2015, Pham et al. 2019). Furthermore, middlemen reduce the amount of time required by fishers to market their own products, this is especially important when there are individuals who may not be able to perform these tasks due to limited education and/or experience in trading and negotiating (Pham et al. 2019). Fishers may also receive financial guarantees from the middlemen during fishing seasons (Pham et al. 2019). There is, however, a clear power imbalance between fishers and middlemen. The fishers are selling a perishable good, often with little to no access to cold storage, while tending to have limited knowledge of the prices offered by the onward buyers (Pham et al. 2019). Consequently, middlemen can influence the price for both upstream and downstream actors to their benefit (Pham et al. 2019).

Most tuna, from both Handline and Pole-and-line fisheries, is then sold to either local distributors or exporters, either whole or as loins (Alimina et al. 2015). During final steps, the product is sold to retailers and consumers where it will typically be disaggregated into three main groups: fresh tuna, frozen tuna, or prepared and shelf-stable canned tuna (Gillett 2015, Kahn 2019). Yellowfin tuna can be found throughout all three groups, whilst skipjack is primarily used for exported canned tuna (IPNLF 2016).

In order to understand the characteristics of the handline (HL) and pole-and-line (PL) tuna fisheries value chains, we conducted a value chain analysis across each of the three case study sites; Ambon, Bitung and Kendari. Our findings across each site have been disaggregated by the associated fishing gear used on the vessels of the respondents i.e. handline or pole-and-line (see Table 5). In all three value chains, the tuna caught goes to locally based processing firms, in some cases via an intermediary agent (supplier, trader or middleman) beforehand. Processors and intermediary agents are, in some cases, involved in financing the fishing trip. The majority of the processed tuna across the case study sites is exported to higher value markets, with lower grade tuna sold into the domestic and/or local markets, thus contributing to local food security. Many crew members are employed based on verbal contracts and are paid through a catch-share agreement. In general, costs are covered by boat owners or processing firms and as a result, fishers often sell their catch to the financiers as part of the agreements.

Table 5. Number of respondents and amount of tuna caught per vessel per year disaggregated by gear and location [1]

Description	Ambon	Bitung	Kendari
Number of respondents (fishermen)	20	20	17
Number of respondents using HL	16	11	13
Number of respondents using PL	4	9	4
Number of HL vessels	16	11	8
Estimate of the amount of HL YFT tuna caught (kg/year/vessel)	2,848	37,127.27	53,508.38
Number of PL vessels	3	2	3
Estimate of the amount of PL YFT tuna caught (kg/year/vessel)	8,222.33	23,538.50	12,333.33
Estimate of the amount of PL SKJ tuna caught (kg/year/vessel)	112,060.00	392,777.67	69,333.33

[1] More detailed value chain analyses by fishery and location are provided in Appendix D. In this section, key points are presented by location. Results (including quantity of tuna caught and traded) are based on the data collected through the survey.

3.1.1 Handline Tuna Fisheries Value Chain Characteristics

The vessels covered in this study use traditional handline techniques, whereby fishers use a single line with a hook attached at the end. Crew from 35 handline vessels were interviewed for this survey. Handline fishing trips typically last between one day and two weeks, however, answers from this survey ranged from 13 hours to 21 days. Crew sizes ranged from 1-15 individuals and yielded anything from 50 kg to 3000 kg per trip depending on the length of the trip. Vessels tend to have onboard cold storage and store the catch on ice slurry.

In Ambon, handline fishers are active at sea alone, with only 3 respondents working on two-man vessels. Trips last an average of 14.6 hours and respondents make an average of 180 trips per year. 13 of the 16 vessels identified in Ambon had outboard engines and one vessel was classed as 0.1- 4.99 GT. Crew sizes in the Bitung handline fishery were larger than in Ambon (average = 10, min = 7, max = 14); no vessel sizes were recorded for this site in the survey. Fishing trips also lasted longer in Bitung at 15 days on average (min = 7 days, max = 21 days). In Bitung, the average number of fishing trips per year in the handline fishery is 18 (ranging from 8 to 40 fishing trips per year). In Kendari, the average crew size was 9 (min = 5, max = 13) with all trips lasting between 8 and 10 days (average = 9 days). Overall, respondents made an average of 18 trips per year and the size of six of the vessels ranged from 5-9.99 GT.

The Ambon handline fishery targets yellowfin tuna only which is then sold as loins. The average selling price per kg (of loin) is $4 (US Dollars) and varies from $3 to $6, and 87% of the tuna catch is sold directly to processors before being exported to Japan and USA. Using data collected, the total volume sold per year per vessel was estimated at 2,848 kg with a total value of $12,738.81 per vessel per year (Table 6).

The Bitung handline fishery also only targets yellowfin. The average selling price per kilo varies depending on the grade quality of the tuna. High grade yellowfin tuna sells at a higher price (average prices per grade are: $4.40 per kg, $4.2 per kg and $2.30 per kg for grade A, B, C tuna respectively, Table 6) rejected tuna sells for $0.60 per kg. Based on the data collected, the average quantity of yellowfin tuna sold per vessel was estimated to be 37,127kg, equating to an average value of $126,154 per vessel (Table 6). In Bitung, the value of yellowfin tuna increases greatly after processing: buying price before processing varies between $2 and $5 per kg (not including rejected tuna), with the selling price of processed fresh yellowfin tuna reaching up to $15 per kg. However, the selling price of frozen yellowfin is lower - between $2 and $3 per kg.

In Kendari, most of the yellowfin and skipjack tuna are sold to middlemen: 81% of the yellowfin and 91% of the skipjack. The remaining yellowfin tuna is sold to processors (13%) and wholesalers (6%). The remaining 9% of skipjack tuna is sold to wholesalers (see Appendix D for value chain mapping). Further research is required to determine the end markets for these products.

Table 6. Volume (kg) and value ($) per vessel per year for the handline fishery of yellowfin and skipjack in Ambon, Bitung, and Kendari

Case Study Site (n= number of vessels)	Tuna Species	Average number of trips per year	Total volume caught (Kg/trip)	Total volume sold (Kg/trip)	Average value per day ($)	Total volume sold per year per vessel (kg)	Total value per vessel per year ($)
Ambon (n=16)	Yellowfin	172	551	268	1,164	2,848	12,739
Bitung (n=11)	Yellowfin	18	ND	25,400	ND	37,127	126,547
Kendari (n=8)	Yellowfin	17	10,017	25,767	1270	53,508	24,942
	Skipjack	17	3,683	15,933	1572	32,242	28,619

Crew earnings were also assessed (Table 7). In Ambon, the crew earnings vary greatly in the handline fishery, with skippers earning on average $77 per trip, one owner earning $34, and crew members $35. In the Bitung handline fishery, fishers are paid through catch-share agreement and earn $318 per trip on average. Handline fishers earn an estimated $0.88 per hour worked. In Kendari, on average, owners earn $184 per trip and crew members earn $54 per trip. In both cases there was a large variation amongst respondents. Most respondents are paid through catch-share agreements, but one owner had a short term contract with one skipper and nine crew members. In Kendari, fishers in the handline fishery work 3,888 hours per year (Table 7). Boat owners in the Kendari handline fishery earn $0.85 per hour worked, whereas handline crew members in Kendari earn $0.26 per hour.

Table 7. Average income ($) per trip and per year for skippers, owners, and crew in the Ambon, Bitung, and Kendari handline fisheries [2]

Site	Fisher Type	Average number of fishing trip per year	Average earning per fishing trip ($)	Estimated number of hours worked per year	Estimated earning per year ($)
Ambon	Skipper	180	77	2574	13,860
	Owner	180	34	2574	6,120
	Crew	180	35	2574	6,300
Bitung	Skipper	18	318	6480	5,724
Kendari	Owner	18	184	3,888	3,312
	Skipper	18	57	3,888	1,026

[2] No data was available for crew or owners in Bitung, nor for crew in Kendari

3.1.2 Pole-and-line Tuna Fisheries Value Chain Characteristics

Vessels are often constructed out of wooden materials; however, they vary in size and typically have a crew between 15 and 50 local fishers. Trips range between three days to two weeks and can land anything between 1,000 to 10,000 kg per trip. However, vessels generally do not have sufficient cold storage onboard. The catch is returned to shore and transported to a local factory where it is typically processed into canned tuna or Katsuobushi. The fishery is highly selective with 90 – 95 % of all catch being the target species.
In Ambon, fishing trips last eight days on average in the pole-and-line fishery and the average crew size is 23. In Bitung, fishing trips last five days on average in the pole and line fishery, and vessels make a total of 53 trips per year on average, approximately 265 fishing days in total. In this pole and line fishery, crew sizes averaged 14. Fishing trips in Kendari lasted nine days on average. The pole and line fishery in Kendari also had a relatively small number of trips per year with seven trips conducted annually.

The average selling price of yellowfin tuna in the pole-and-line fishery in Ambon is $1.10 per kg, while skipjack is sold for $1 per kg on average. Based on the data collected for Ambon, 8,222kg of yellowfin tuna and 112,060 kg of skipjack tuna was sold per vessel over the year, generating $8493 and $106,124 per vessel respectively (Table 8).

In Bitung, the pole and line fishery annual sale of yellowfin tuna was estimated to be 123,584kg, at a value of $151,390 per vessel (Table 8). The amount of skipjack tuna sold was much higher with 392,778kg for a value of $646,917 per vessel.

In Kendari, the yearly amount of tuna caught by the pole and line fishery was estimated to be 12,333 kg of yellowfin tuna (15% of the catch), and 69,333 kg of skipjack (85 % of the catch per vessel) (Table 8). The estimated value of the annual yellowfin tuna production was $11,235 per vessel and $49,700 per vessel for skipjack tuna. Most of the yellowfin tuna is sold to processors: 68% of annual catches. Half of the skipjack tuna (52%) is sold to middlemen.

Table 8. Volume (kg) and value ($) per vessel per year for the pole and line fishery of yellowfin and skipjack in Ambon, Bitung, and Kendari

Site (n=number of vessels)	Tuna Species	Average number of trips per year	Total volume caught (Kg/trip)	Total volume sold (Kg/trip)	Total value per day ($)	Total volume sold per year per vessel (kg)	Total value per year per vessel ($)
Ambon (n=3)	Yellowfin	25	3,000	3,000	131.25 (8 day trip)	8,222.33	8,493
	Skipjack	25	15,338	15,157	1810.50 (8 day trip)	112,060	106,124
Bitung (n=2)	Yellowfin	53	4,833	247,167	300 (5 day trip)	123,583.50	151,390
	Skipjack	53	11,167	579,833	3,000 (5 day trip)	392,777.67	646,917
Kendari (n=3)	Yellowfin	7	6,000	6,000	618.33 (9 day trip)	12,333.33	11,235
	Skipjack	7	29,000	29,000	2,333.33 (9 day trip)	69,333.33	49,700

In terms of crew earnings, in the Ambon pole and line fishery, skippers and crew members earn $97 per trip on average (Table 9). Across the nine pole and line fisher respondents in Bitung, the estimated total number of hours worked per year was 6360, with some fishers being paid through catch-share agreement and others via permanent employment arrangements. In Bitung, owners earn $1,400 per trip on average and crew members earn $64 per trip or $0.53 per hour worked. Four pole-and-line fishers were interviewed in Kendari, and all declared being paid through catch-share agreements, earning $1,288 over the year and an average earning of $184 per trip

Table 9. Average income ($) per trip and per year for skippers, owners, and crew in the Ambon, Bitung, and Kendari handline fisheries

Site	Fisher Type	Average number of fishing trip per year	Average earning per fishing trip ($)	Estimated number of hours worked per year	Estimated earning per year ($)
Ambon	Crew	23.5	97	4512	2,139
Bitung	Pole and line - owner	53	1,400	6360	74,200
	Pole and line - crew	53	64	6360	3,392
Kendari	Crew	7	184	3,360	1,288

3.2 Socio-economic Indicators

Our second research question explores what socio-economic benefits are accrued by fishers from their fishing activities. Survey participants were asked to provide information around four themes: poverty alleviation, income security, food security, and local employment. Handline and pole and line fisheries tended to have differing characteristics regarding crew and vessel size, onboard storage facilities affecting the quality of the produce, and business arrangements with processors and middlemen - as a result, the socio-economic indicators were disaggregated by gear (Table 10). Our results show income earned from small-scale fishing in our sites is a key factor in keeping the participants above the national poverty line, while benefits such as direct access to whole tuna and any parts of fish which are not sold as well as non-target species landed (i.e. neretic tunas) contribute to the mitigation of food insecurity. Handline and pole and line fishing was also shown to contribute to the local economy since many fishers are Indonesian nationals (all participants in this study were Indonesian nationals), most of whom had spent between 13-41 years in HL and PL fisheries, as a result there is a wealth of practical and cultural knowledge that is available within the communities.

Table 10. Results of the socio-economic indicator analysis for Ambon, Bitung, and Kendari disaggregated by gear (handline and pole and line) and theme (poverty alleviation, income security, food security, and local employment)

Theme	Indicator	Metric	Ambon		Bitung		Kendari	
			Handline	Pole and Line	Handline	Pole and Line	Handline	Pole and line
Poverty Alleviation	Poverty line (IDR 437 902 per month)	% above	100	100	100	100	85.8	100
		% below	0	0	0	0	14.2	0
	Regional income	% above	100	50	72.7	37.5	0	0
		% below	0	50	27.3	62.5	100	100
Income Security	Choice to sell	% yes	87.5	25	81.8	0	28.6	0
		% no	12.5	75	18.2	100	71.4	100
	Reliable payment system	Average difference between estimates		NA	0.37	0.37		
	Fisher income as a % of total catch value	Average	59.64	2.4	NA	NA	3.27	2.21
		Maximum	100	3.19	NA	NA	5.56	3.43
		Minimum	25.57	1.62	NA	NA	0.6	1.35
Food Security	Market	% to export	84	80.5	NA		68	68
		% to local	16	19.5	NA		32	32
	Participant consumption of tuna as a % of national fish consumption (47.37 kg)	Average	23.57	208.9	105.96	54.7	-2.2	29.31
		Maximum	156	284.45	284.45	284.45	92.23	175.6
		Minimum	-100	119.69	-100	-100	-63.4	-45.08
	Regional consumption as a percentage of		28.58	28.58	27.25	27.25	24.22	24.22

	the national fish consumption							
Local Employment	Non-residential employment	% from same province as site	86.7	50	72.7	88.8	0	25
		% from different province to site	13.3	50	27.3	11.2	100	75
	Industry retention (number of years in industry)	Average	13	18	18	22	17	41
		Maximum	38	28	28	33	45	39
		Minimum	2	6	1	3	1	46
	Age distribution	Average	42	44	41	42	36	60
		Maximum	62	62	48	57	60	71
		Minimum	31	24	29	27	19	50

3.2.1 Poverty Alleviation

The data collected under this theme indicates the importance of income derived from the Handline and Pole-and-line fisheries to poverty alleviation in Indonesia. Two factors were assessed: the extent that income received from fishing activities was above the national poverty line, and the extent that income derived from fishing activities only put recipients above the average regional earning in their province.

Handline Fisheries

The results indicate that all fishers in Ambon and Bitung handline fisheries generate income from their fishing activities that places them above both the national poverty line and most above the average regional monthly wage. Handline fishers in Bitung earned the most out of the three sites on average with 72.7 % earning above the regional rural average monthly income. The Kendari handline fishery was the only fishery in this study where respondents earned below the national poverty line. All respondents in Kendari were migratory fishers from the neighbouring province (West Sulawesi) but earned less than the average regional rural income in both provinces. These results show that income from fishing activities alone allows for fishers to maintain minimum individual subsistence levels without factoring any potential secondary sources of income. Income derived from handline fisheries compared favourably relative to average income levels in both Ambon and Bitung. Although this was not the case in Kendari, due to the migratory nature of the HL fishery it is likely that the income generated from seasonal fishing in other areas over the course of the year would exceed the minimum income levels covered by these indicators.

Pole-and-line Fisheries

All respondents in Ambon earn above the national poverty line, however, only 50% earned more than the regional average rural monthly income. In Bitung 100% of respondents earn above the national poverty line and 37.5% earned more than the regional rural average income. The Kendari pole-and-line fishery is similar to the other fisheries in this study in that all respondents earned above the poverty line, however no fishers reported earning more than the regional average monthly income. These results suggest that adopting pole-and-line fishing as a livelihood strategy allows individuals to meet minimum subsistence requirements without needing to pursue alternative income avenues.

3.2.2 Income Security

This theme assesses three indicators of income security across the case study sites: choice to sell, reliable payment systems, and fisher income as a percentage of total catch value.

Handline Fisheries

Across the fisheries in this study, Ambon had the largest proportion of fishers (87.5%) that expressed that they felt free to sell their catch to any actor or company in the port. Handline fishers in Ambon also earned the greatest proportion of income as a percentage of their total catch value, with fisher income being 59.64% of the total catch value. This high percentage can be explained by most fishers in Ambon either owning the boat or working on single crew

vessels, enabling fishers to be more economically autonomous and the distribution of income only concerns themselves and their buyer. In Bitung, most fishers (81.8 %) felt they had the choice to sell whomever they wish in the port, but income distribution as a share of catch value could not be determined due to insufficient data. Finally, Kendari had the lowest proportion of fishers reporting being able to sell to whomever they wish (28.6 %), and they receive an income between 0.60 % and 5.56 % of the total catch value (average = 3.27 %). In all locations the reasons given for not having a choice about whom to sell to were that the processors or a middleman were financing the fishing trips, and that the tuna caught had to be sold to them in exchange for this service.

Results from Bitung and Kendari highlight the importance of the structure of the tuna value chain in fishers proportional share of the catch they are landing. Where value chain actors such as boat owners, middlemen and/or suppliers were present, fishers expressed lower levels of proportional catch share received and/or lower levels of operational/financial knowledge in general.

Pole-and-line Fisheries

In Ambon, 25 % of pole-and-line fishers were able to choose who they sold their catch to whilst no respondents were able to do so in Bitung or Kendari. Whilst only fishers in Bitung were able to provide sufficient information regarding the distribution of pay, with very similar estimates given by both crew and owners (difference of 0.37 % on average), they were not able to provide information regarding their income as a percentage of total catch value as they did not know the final amounts and prices of fish being sold (in part due to the grading system that is used). Conversely, respondents in Ambon and Kendari were not able to share information regarding pay distribution yet were able to share the amounts and prices of tuna being caught and sold, thus their income as a percentage of total catch share was calculated (2.4 % and 2.2 % on average, respectively). Furthermore, the range for these indicators was relatively small (Ambon: min = 1.62 %, max = 3.19 %; Kendari: min = 1.35 %, max = 3.43 %).

3.2.3 Food Security

Handline Fisheries

In Ambon and Kendari the majority of handline tuna caught was exported with 84% and 68% of total catch exported respectively. The remaining tuna that is not exported is often a lower graded product and therefore not accepted by higher value export markets. Even though the majority of tuna landed was exported in both Kendari and Ambon, the results from this indicator show that fishing contributes to the healthy seafood consumption for regional residents and a decline in fishing may have adverse effects on the food security of individual households as well as the region as a whole. The data gathered for this study did not allow the researchers to discern the percentage of tuna landed in Bitung that was sent to local and export markets due to either a lack of knowledge or unwillingness to share information regarding amounts of fish sold and the destination of the product on the part of respondents. However, the value chain analysis documents the connection of this fishery to export markets and anecdotally the research team are aware that the fishery will likely export a similar proportion of tuna to export markets.

Across all three sites fish consumption was above the national average evidencing the regional importance of fish in local diets. In Ambon the regional average fish consumption was highest at 28.58 % higher than the national average fish consumption. In Bitung and Kendari regional fish consumption was lower than in Ambon, but still 27.25 % and 24.22 % higher respectively than the national average of fish consumption. On average, respondents in Ambon consumed over three times the national fish consumption in tuna alone. All respondents stated that they ate skipjack carcass, along with other cuts and species of tuna. The fact that there is limited cold storage on Ambon due to challenges in electricity supply, as well as the fact that many of the fishers own the vessels, suggests that access to the fish (in particular the carcasses) is free; as a result, household food costs are alleviated through fishing activities. Kendari was the only fishery where the respondents consumed less tuna than the national and regional average fish consumption, however, they did eat 97.8 % of the national fish consumption in tuna and, consequently, it is still evident that it is an important food source and can still alleviate household food costs.

Pole-and-line Fisheries

The majority of tuna landed in Ambon and Kendari was exported (80.5 % and 68 % respectively), however, there was not sufficient information to calculate this indicator for Bitung. Despite the high proportion of tuna being exported, the average regional fish consumption in each area was greater than the national fish consumption (Ambon: 28.58 % more, Bitung: 27.25 % more, Kendari 24.22 % more). This suggests that the tuna from the pole-and-line fishery contributes to the national export economy as well as supporting healthy seafood consumption locally.

In the Ambon pole-and-line fishery, fishers consume three times the national average consumption of fish in tuna alone, it is likely that this contributes greatly to the alleviation of household food costs as well as contributing to household nutrition. In Bitung, on average, respondents consumed more tuna than the average national fish consumption (54.7 % more than the national average). In Kendari, fishers consumed 29.31 % more tuna than the national average fish consumption. These indicators highlight the importance of tuna in supporting food security in the region and, more specifically, in fishing households.

3.2.4 Local Employment

The data collected under this theme assesses the economic contribution of the industry to the local economy through income generation in the harvesting sector to either the adjacent coastal communities or to communities further away but still nationally in Indonesia, as opposed to leaving national and regional economies. This theme utilised four indicators. The first indicator assesses the proportion of non-national harvesters working in the fishery. This indicator demonstrates whether much of the harvesting wealth will be leaving the country and failing to boost the domestic economy.

The second indicator assesses the proportion of non-resident national harvesters working in the fishery. This indicator demonstrates whether much of the harvesting wealth that remains in in Indonesia will be leaving the province with internal national migrants who still benefit the domestic economy through their fishing activities. It aims to capture the extent of financial benefit to provinces and households that are outside the province in which the fishing activity is taking place and the fish is being landed.

The third indicator assesses the rate at which the crew force turns over in the fishery. It reflects wealth accumulation to crew because a crew member will only stay in the fishery if the wage is comparable to, or better than, other jobs he could obtain. Crew longevity may also mean earnings are more likely to stay in the community and are spent locally, rather than being sent away by itinerant or immigrant crews. Experienced crew develop specialised knowledge and refined skills that make harvesting more efficient, so the fishery is better able to reach its wealth-generating potential. The final indicator assesses the average age of crews. Better performance is demonstrated by a lower collective average age. A higher proportion of younger fishers entering the fishery implies a healthy state of the sector as it represents a desirable source of employment in comparison to alternative careers. If this indicator scores highly alongside the other two then it is possible to infer the future contribution to the local economy through sustained future income generation.

Handline Fisheries

Across all three sites 100% of the crews were Indonesian nationals demonstrating how harvesting activities exclusively contribute to the income generation of national residents and national households. Approximately 87 % of respondents in Ambon were residents, followed by 72.7 % in Bitung, and 0% in Kendari where all respondents were from the neighbouring province of West Sulawesi. This shows that fishing contributes to local employment and the local economy, however, it also highlights the migratory nature of fishing as a livelihood in some instances (as in Kendari). In Ambon, given the average age of respondents is 42 and the average number of years spent in the fishery is 13 years (min = 2, max = 38), with the oldest respondent being 62 and the youngest being 31. The average age of fishers in Bitung is 41 and has the smallest age range (min = 29, max = 48). Respondents had been engaged in small-scale fisheries between 1 and 28 years (average = 18). Kendari had the widest age range and the youngest respondent (average = 36, min = 19, max = 60); the average number of years in the fishery was 17 years (min = 1, max = 45). Given these results, it is likely that small-scale fishing is adopted as a long-term livelihood strategy and thus has sufficient benefits and livelihood security. Furthermore, the extended periods of time engaged in the fishery suggests that both earnings and specialised knowledge are likely to stay in the community thus contributing to the fishery's wealth-generating potential. However, there are fewer young individuals engaging in the fishery and so it will be important to take into consideration when calculating the benefits and reliance on the fishery in the future.

Pole-and-line Fisheries

All respondents within the pole-and-line fisheries were from Indonesia. In Ambon 50% of respondents were residents in the city, 88.8 % were residents in Bitung, and 25% in Kendari where all respondents were from the neighbouring provinces. This shows that fishing contributes to local employment and the local economy. In the pole-and-line fishery in Ambon the average number of years in the fishery was 18 years, with a minimum of six years and a maximum of 28 years, this suggests there are sufficient non-monetary benefits to continue pursuing a livelihood in this fishery. In Bitung, the average number of years in the fishery is 22 years - the greatest average amount compared to the other sites in this study - therefore it may be inferred that, despite the relatively lower income in Bitung, there are sufficient benefits to remain engaged in the fishery. The number of years in the fishery may also indicate good job security, this may be related to the fact that there is an overcapacity at the processing level and so there is consistent demand for raw products (Bailey et al. 2016, Longdong et al. 2020). The pole-and-line fishery in Kendari is different to the other fisheries as it has the highest average age (60 ± 4 years), yet the average number of years engaged in the fishery is 18 ± 2 years. This suggests individuals have joined the fishery at a later stage in their lives, thus it may be inferred that fishing is an important livelihood safety net. The longevity of engagement in the fishery suggests that the non-income benefits (see section 3.2.1 regarding relative regional income) are sufficient to continue to pursue the livelihood; it also suggests there is an accumulation of specialised knowledge which can be shared and contribute to the wealth-generating potential of the fishery.

4. Discussion

This study was developed to address the need to identify the socio-economic characteristics of the tuna handline and pole-and-line value chain, and capture information which will be valuable to the Indonesian government efforts developing the country's prospective Harvest Strategy and Harvest Control Rules. Considering welfare-based fisheries management and safeguarding socio-economic benefits to small-scale fishers can only be achieved if there is a robust understanding of the socio-economic benefits and how they are distributed - if not, there is a risk that coastal communities (especially the more vulnerable members within coastal communities) will be negatively impacted. As such, the discussion is structured in a way that follows a linear value chain narrative (Figure 6), building information around each step in the process, leading to a set of recommendations regarding the inclusion of socio-economic indicators that may enhance the social and economic sustainability of the entire value chain by informing the harvest strategy.

Figure 6. Key components and associated processes of the value chain

4.2 Fishing

Fishers using handline and pole-and-line gear are the main actors at this stage of the value chain. However, in order for them to be able to conduct these activities credit is often required from private actors, such as processors and middlemen, in order to cover costs such as food, bait, fuel, and gear. The amount of credit required is influenced by the gear being used and the length of the fishing trip. Access to credit will be influenced, at least in part, by social capital (relationships between captains and financiers). There are two key outputs at this stage: the harvested product (economic output) and the actual pursuit of small-scale fishing as a livelihood activity (socio-economic output). Private actors that are financing fishing trips appear to provide an essential service capitalised by fishers, supporting livelihood security and the production of knowledge as fishers are able to pursue fishing for many years. With costs and overheads of fishing trips covered some fishers are still only existing at around the poverty line in terms of their income generated. Understanding the nature of the financing mechanisms is therefore vital in order to safeguard the incomes of fishers. It is important to understand to what extent fishers are reliant on the financing provided to them by their patrons, and how this impacts their take home income.

Indicators for the theme of poverty alleviation are particularly relevant at this stage of the value chain, showing a minimum level of income derived from the fishery that enables individual economic subsistence. It is important to note that some fishers are likely to participate in other livelihood activities and/or other types of seasonal fisheries. For example, most fishers take up alternative livelihoods during the low season, as well as or instead of borrowing money. Whilst none of the participants within the sample for this study stated pursuing alternative livelihoods, the indicators did allow for this information to be captured. In Kendari and Bitung, many fishers will either take up carpentry or will provide taxi services using motorbikes, also known as ojek. Whereas in Ambon, fishers tend to go into farming of crops, such as cassava, clove, sweet potatoes, and generally invest their income in farming rather than in fishing (Personal Correspondence).

4.3 Sale

4.3.1 The Role of Tuna

Once the tuna is harvested it is either sold to processors, local markets, or in some cases will be directly consumed by the fishers. The quality of the tuna caught, as well as cold storage conditions on the vessels, can influence the sale of the fish. In each location, processors mentioned experiencing issues with damaged tuna and tuna not being well preserved. The tuna retrieving the higher price (often exported) is tuna that has been well preserved and iced, sold fresh and undamaged to the processors. As processors manage to retrieve much higher prices for top quality yellowfin tuna, one option to support small-scale fisheries could be to encourage investment that enables better conservation and preservation of tuna from the time it is being fished to the moment it's sold to processors.

Based on our data, improving cold chain management of tuna caught could raise the price of products, and subsequently the incomes of fishers. However, lower graded tuna that is not fit for export is consumed directly by fishers and coastal communities. Therefore, increasing the quality of tuna and income generated from sales could undermine the direct food security benefits of tuna fisheries as they currently operate. Moreover, fishers financially benefit from being able to consume lower graded catch as it negates expenditure on sources of protein for themselves and their households. In a scenario where cold chain management and the quality of tuna caught improve significantly, a cost benefit analysis would need to be conducted to understand if any potential gains in income would offset the money that would subsequently need to be spent on fish products.

4.3.2 Take Home Income

The take home income of fishers is impacted on by two "filters". The first is deductions in the value received from the catch as a form of credit repayment to the financiers of the fishing trip. This filter must be applied when estimating the impact of changes in fishing levels on the income generation of fishers. The second is how the remaining catch value is split at the vessel level between different types of roles on the vessels. Catch-share arrangements are key and how these are composed in practice are a key factor in determining take home income. Furthermore, the results from this study show that most agreements are verbal rather than written contracts, once again highlighting the importance of social capital and networks.

The take home income derived from the sale of catch contributes to poverty alleviation within local coastal communities. Our results show that in most cases, income from small-scale fishing as the primary, or sole, livelihood activity is sufficient to prevent fishers living under the poverty line and, in some cases, earn the equivalent or more than the regional monthly income. Catch-share system configurations are influenced by the presence of intermediary agents such as middlemen, suppliers and traders, and understanding how the impact fishers income is essential for understanding the impact of management decisions. Moreover, catch-share system configurations are key for understanding impacts on, and determining, the incomes of fishers under any policy or management changes to fishing activity. Some fishers are more vulnerable than others due to smaller proportions of catch share and tighter margins to relative poverty lines.

4.3.3 The Role of Relationships in Income Security

Take home income is a key output at this stage of the value chain. Results from the Income Security theme evidence a range of insights regarding equity of income, as well as highlighting opportunities for safeguarding income security. In this sense the structure of the fishery value chain is important in indicating risks to economic freedoms. However, assessing the relationships between fishers and their patrons is crucial for determining the nature of risk to income security. Where catch share payment systems are in place, crew members, captains and vessel owners should be able to evidence a shared understanding of these. This is an important dynamic to display that the payment systems are transparent and well understood by all parties. small-scale fishers have been shown to derive more value from less catch (IPNLF 2014), which implies more money proportionally going to the more traditionally vulnerable members of the supply chain.

'Supporting actors' (i.e. those not directly involved in the capturing or processing such as crew and factory workers) are involved in financing fishing trips and are owners of the "physical capital" used by the fishers (i.e. the vessel, fishing gear etc). This type of financing acts as a de facto form of credit that fishers have to pay back through a proportion of their catch value. While this can facilitate more income stability as the financial risk is taken by the producers and middlemen rather than the individual fishers, it also depends on how such financial arrangements are configured in practice and more research is required to infer how such relationships impact the income security of the fishers in our sample.

In cases where vessels were owned by the processing companies, very few fishers engaged with middlemen. As a result, fishers likely have less autonomy regarding the price they sell their fish for. The inability to provide information regarding their income as a percentage of total catch value as they did not know the final amounts and prices of fish being sold] shows there is a potentially important connection between transparency of payment distribution and wealth generation. Results from the choice to sell indicator suggest there are potential opportunities for power imbalances due to lack of transparency in the supply chain payments, however the fact that fishing trips are financed by the processor with a guaranteed purchase means the fishers are not required to take on as much financial risk.

4.4 Local and Export Markets

The data regarding the buying and selling price from processors in this study is fragmented; however, it appears that processors pay higher prices to purchase handline caught yellowfin tuna. Whilst there is not enough data to give results by fishing gear, our findings show that processors were able to sell yellowfin tuna at a much higher price than the purchase price. For instance, in Ambon, the average buying price for a kg of yellowfin tuna handline caught is 4.20 USD and the average selling price is 7 USD. In Bitung, the selling price for yellowfin tuna can reach 14.7 USD/kg. In comparison the highest buying price is 5.08USD. The high prices seem to be linked with exports to Japan and the USA. In comparison, buying and selling prices of skipjack tuna are much lower. On average processors pay between 0.95USD/kg (in Kendari) and 1.05USD/kg (in Ambon) and the selling value is closer to the buying price (1.37USD/kg in Kendari). Processors manage to retrieve the highest price (almost 3 times the price of tuna sold on the domestic market) for exported tuna (to the USA and Japan). These sales contribute to the national economy which can then be distributed to the benefit of resource dependent coastal communities. A smaller amount of tuna is sold to the local markets, however, the supply chain does still contribute to national fish consumption and food security, as well as the local economy.

Both the local and export markets are essential for fishers to be able to pursue this livelihood activity. Small-scale fishing is adopted as a long-term livelihood strategy; as a result, if fishing became more restrictive through lower permitted fishing levels and forced individuals out of this sector, alternative livelihood options for these individuals would need to be assessed alongside the subsequent income generation that could occur, and impact on poverty levels should be considered. Other factors, such as social capital and contributions to household food security (as outlined earlier in the discussion), would also need to be carefully considered.

4.5 Further Considerations

This study showed that the HL and PL tuna supply chains make multiple contributions to the wellbeing of both fishing and non-fishing communities in Indonesia. A key limitation of adopting a nonprobability sampling approach is that researchers are subjective and may show bias in choosing the participants of the study and, particularly in the case of convenience sampling, if there are low numbers of participants they may not be representative as the sampling is not necessarily accessible for all individuals (Etikan et al. 2016). To address these limitations and increase representation participants were engaged from multiple sites and roles and there were multiple field enumerators. These sampling approaches were also careful to accommodate the impacts of COVID-19 so that enumerators were able to ensure that they would not interact with any individuals who may have been vulnerable or self-isolating. Furthermore, these approaches can be implemented quickly (Battaglia 2008), this was particularly important to minimise time in the field as well as for efficient sampling given that survey time had been reduced due to the COVID-19 pandemic. Furthermore, a collaborative study was carried out by the Centre for Marine and Socio-economic Research, the Centre for Research and Human Resources for Marine Fisheries, and the MMFA (2021) and were able to capture large amounts of socio-economic data, evidencing that large-scale, socio-economic data collection is possible.

While most of the indicators were easily captured - the “reliable payment system” indicator was not effectively captured in any of the sites because different, inconsistent and subjective terminology was used i.e. point vs percentages. As such, it may be difficult to scale up, and implement this indicator. However, it may be possible to apply this indicator in other sections of the value chain where there are more formal agreements. Information for this indicator was also missing as many of the crew stated that they did not know how the payment was distributed - this in itself is an interesting result as it speaks to information and knowledge sharing, empowerment, and potentially hints at uneven power dynamics. This suggests that further research into the specific dynamics and relationships between fishers, middlemen, and vessel owners is required to help to elucidate such nuanced relationships, and identify opportunities to address their effects on socio-economic outcomes.

5. Socio-economic Policy Implications

This study identified key actors and processes within the handline and pole-and-line tuna value chains, capturing the distribution of both monetary and socio-economic benefits throughout the supply chain. Our results highlight the importance of socio-economic benefits of handline and pole-and-line tuna fisheries in Indonesia, whilst also demonstrating the importance of the careful selection of indicators as there are interactions that may influence other areas of the value chain. When developing policy and management plans, it is necessary to consider both the direct and indirect impacts Harvest Strategies and Harvest Control Rules could have on the wellbeing of Indonesian citizens.

The socio-economic indicators identified through this study yielded important results in an efficient manner and proved viable for generating socio-economic baseline data that can inform management decisions. These outcomes should therefore help secure and maximise the potential positive social and economic impacts of future policy decisions. The subsequent policy implications per theme are summarised below:

5.1 Poverty Alleviations Policy Implications

The poverty alleviation indicators help provide important insights regarding the most vulnerable fishing households to quota or allocation changes. Those which earn below, or only slightly above, the national poverty line may not have the monetary savings or economic capacity to properly compensate for any decline in financial or food benefits derived from fishing if their catch levels are restricted. Therefore this indicator provides the required context to ensure that any decision to reduce allocation of catch to vulnerable fisheries or regions can be made with the view of safeguarding communities closer to the poverty line, so as to not perpetuate their financial vulnerability.

5.2 Income Security Policy Implications

The income security indicators developed for this study proved effective in identifying groups at greater risk from changes in purchasing behaviours - which will likely be impacted by policy decisions. These groups may differ from at-risk groups identified using the poverty alleviation indicators because, whilst individuals may currently earn above the poverty line, the lack of freedom of choice regarding whom they sell to means they may face limited alternative purchasers, or opportunities for negotiation when there are changes in purchasing behaviour. Understanding how catch share systems are configured is essential for assessing how restrictions on fishing activities may impact different types of crew members on board. By having data which is consistent and comparable across payment systems, policy makers are able to make informed decisions about the economic impact of management policies upon fishing communities using different forms of catch or profit share systems.

These indicators also highlight situations where individuals are not aware of, or don't fully understand, the payment (or benefit) distributions, and are therefore potentially susceptible to financial exploitation. Whilst not unique to the seafood industry, it is important that policies do not perpetuate, or provide enabling conditions for, such negative interactions. Finally, these indicators are uniquely appropriate for tracking the income derived from fishing based on various payment systems (i.e. fixed salary vs. catch-share system), allowing for an accurate understanding of the relationship between catch landed and the income generated by crew.

5.3 Food Security Policy Implications

The food security indicators explored in this study helped to identify communities and/or areas with a high dependence on fish as part of their diet, and therefore those who would be at greatest risk of food insecurity and/or reduced financial capital if their catch allocation is lowered. By consuming fish directly caught from the vessel at low or no cost, many fishing households are able to supplement their nutrition and alleviate household food costs, allowing for greater savings or investment in other areas of their lives. This can help negate individual and household spending on protein sources as well as act as an important source of micronutrients. By factoring food security indicators into policies, the often overlooked benefit of household consumption of tuna directly from their own operations can be duly accounted for when allocating catch.

5.4 Local Employment Policy Implications

The local employment indicators explored in this research helped identify fishing communities where there are individuals with high employment retention and a strong cultural heritage associated with fishing compared to the capture rate of new fishers entering the sector, thus tracking the influence upon their socio-economic performance. High performance on both of these indicators suggests that the fishery is providing a sustainable form of employment to workers, as it is both retaining workers and attracting new workers simultaneously. From a policy perspective these indicators therefore help to understand where areas of the fishing industry are providing fishers with attractive long-term livelihood options. These are qualities that should be preferentially considered when considering the impact of policy decisions to ensure they do not undermine the social benefits of higher performing fisheries.

Finally, through understanding where individuals working on vessels come from, i.e. a different province or country, the local employment indicators can provide insight into the geographical distribution of benefits as well as identify communities which are particularly vulnerable to changes in allocation. For example, if fishers active in Kendari have typically travelled from another province to conduct their fishing operations, the socio-economic impacts of restrictions to fishing activities in Kendari would in fact be experienced by coastal communities elsewhere i.e. the home province of fishers where remittances are sent.

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