Value Distribution across Fish Supply Chains: Mahi-mahi, Peru

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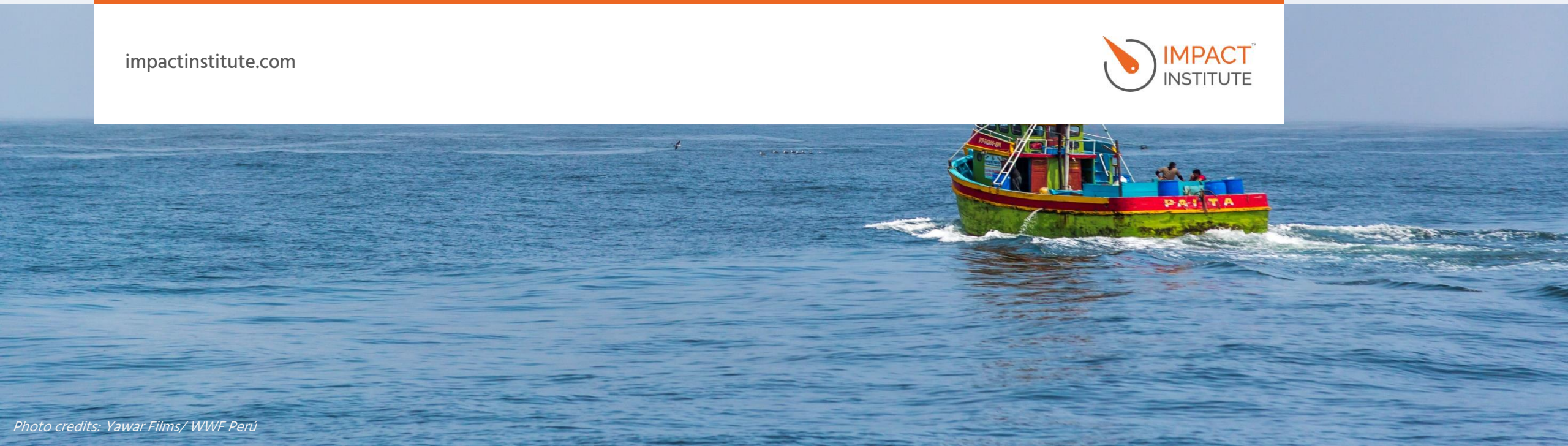

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EXECUTIVE SUMMARY

Walton Family Foundation (WFF), founded in 1987, aims to build support for sustainable fishery practices to improve ocean health and to preserve coastal livelihoods. One of the focus areas in this aspect is to protect rivers and oceans and the communities they support. WFF has collaborated with Impact Institute to gain sufficient actionable information for decision-making and strategy development required to support and preserve fishery communities. The project has consisted of performing two value chain assessments on selected fish supply chains within the operational work of WFF. The selected value chains are the **blue swimming crab (BSC)** from Indonesia and the **mahi-mahi (MM)** (i.e., common dolphinfish) from Peru. The main research questions were:

- How does the value of fish accrue through the supply chain?
- What is the fishers' share of the final product?

The goal of the analysis was threefold: (1) To identify the value distribution per supply chain step for the selected fisheries, (2) determine the presence of underearning faced by fishermen and (3) understand the role of sustainable fishing in the value distribution.

The Peruvian mahi-mahi supply chain presents an unequal distribution of value along the steps. Fishers earn 45% of value accrued per kg of final product, middlemen accrue 16% and processing plants accrue 39%. There is underearning present in the fishery, with an estimated 38% of mahi-mahi fishers earning below than the rural living income. Lastly, future studies are recommended to include questions regarding sustainability since there is currently a lack of data in this regard.

This document summarizes the methodology, results and recommendations for the MM fishery in Peru.

CONTENTS

Introduction

01

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INTRODUCTION OVERVIEW

The analysis is aimed at understanding how value accrues along the supply chain of the Peruvian mahi-mahi

WFF's Oceans team is leveraging the buying power of major seafood importers and engaging the supply chain in building support for sustainable fishery practices to improve ocean health and preserve coastal livelihoods.

WFF has collaborated with Impact Institute to gain sufficient actionable information for decision-making and strategy development required to support and preserve fishery communities. The assessment provides insight into how value accrues across specific fishery supply chains. The main research questions were:

1. How does the value of fish accrue through the supply chain?
2. What is the fishers' share of the final product?

This motivated the formulation of three main goals. First, to identify the value distribution per supply chain step for the selected fisheries. Second, to determine the presence of underearning faced by fishermen. Third, to understand the role of sustainable fishing in the value distribution of fish supply chains.

This document presents the results for the Peruvian mahi-mahi (MM). This fishery is the second largest artisanal fishery in Peru, with 34.8 M kg of landed mahi-mahi in 2019. This presented a total export volume of 8,096 tons, of frozen MM, worth 51,933 million dollars.

This report contains an explanation of the methodology and approach, the main results for each formulated goal, as well as insights and recommendations for equity improvement.

Methodology and Approach

02

Photo credits: Yawar Films/ WWF Perú

METHODOLOGY AND APPROACH PROJECT ACTIVITIES

The assessment has completed 5 main activities, from scoping to reporting

Impact Institute has assessed the value distribution along the mahi-mahi (MM) supply chain in Peru. To do so, several activities have been conducted. This chapter will provide an in-depth explanation of the scope of the analysis, the data used, and the type of models developed.

Activity 1: Scoping

The analysis started by scoping the boundaries of the project. Given data availability and feasibility, the first three steps of the value chain structure are in scope. A detailed overview of the dynamics of the MM fishery is explained on the next page.

Activity 2: Data collection

The analysis has been based exclusively on secondary data given that no primary data was available. To get the most comprehensive overview possible of the entire MM value chain in Peru, numerous reports shared by WFF have been analyzed. This has allowed Impact Institute to understand the dynamics of the fishery as well as to collect essential data points. Further, other value chain data has been collected from other studies. These include sector reports, national statistics and academic studies. However, some required data points were still missing. These were adjusted for using assumptions based on best available information. A complete list of assumptions can be found in the Appendix.

Activity 3: Model building

Building upon the scoping decisions and the available data, a financial model has been built to quantify the value generated at each step of the value chain. Value has been captured as the profit earned.

Further, a separate model has been built to visualize the income distribution at the fisher level.

Activity 4: Analysis and Validation

For each goal of the project, an in-depth analysis has been performed. The analysis presents insights into the inequality present in the MM fishery.

The model and analyses have been validated by multiple members from Impact Institute to ensure accuracy.

Activity 5: Reporting

The results of the analysis and the recommendations are collected in this report.

METHODOLOGY AND APPROACH 1. SCOPING (1/2)

The value chain structure of the mahi-mahi in Peru has 6 main steps in both national and international markets

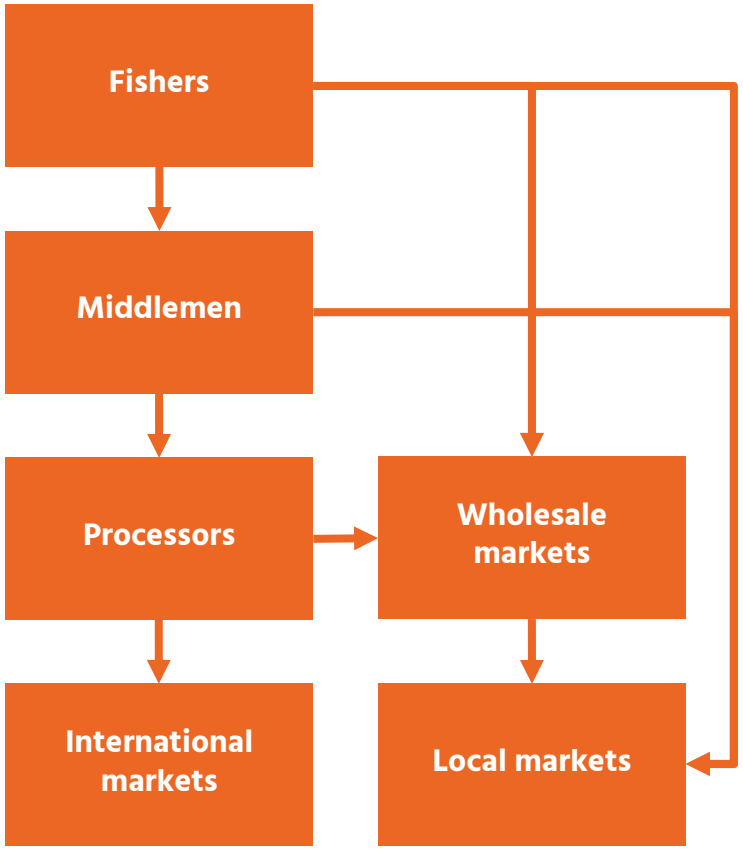
The first step in the value chain is at the harvesting level, where there are approximately 4,300 **fishermen** across the coastline of Peru for whom MM is their main species. All fishermen are part of an artisanal fleet and use longlines as their fishing gear. MM is a highly migratory species with a preference for warm waters and therefore is only fished from October 1st to April 30th. The rest of the year, fishermen typically catch flying jumbo squid, sharks, and skipjack tuna. Boat owners usually "hire" a skipper and crew to undertake the fishing voyages, with the value of product captured being split between the two parties (owner and fishermen) as payment. This split of profit varies by port, boat owner and number of fishers. Shares of 40/60 and 50/50 are the most common.

The next step in the value chain is the **middlemen**, intermediary agents who finance the fisher's operations, buy the landed MM in the port, and then transport it in refrigerated trucks to processing plants or directly to local markets.

Processing plants transform the fish into various frozen MM products to ensure it is ready for export to **international markets**. According to a 2019 report from Future of Fish, half of all landings are exported as frozen MM, of which 81% goes to the US.[1]

Wholesale domestic markets consume the other half of the landings as fresh MM. From the point of wholesale, domestic actors like retail markets, supermarkets, restaurants and households purchase the fish.

The figure to the right visualizes the different flows between agents in the value chain.



[1] Future of Fish (2019). "FISHERY DEVELOPMENT BLUEPRINT Traceability in the Peruvian mahi-mahi Fishery".

METHODOLOGY AND APPROACH 1. SCOPING (2/2)

The scope of the value chain assessment has been limited to the steps bound in the country of analysis aimed at exportation

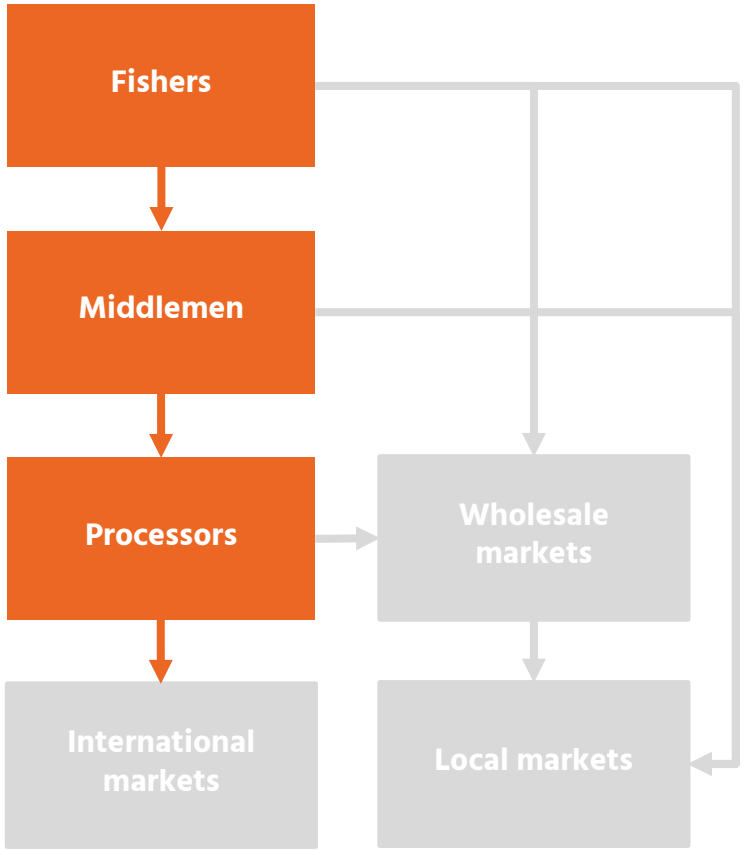
The analysis aims to understand how the value of MM accrues along the supply chain. To do so, the analysis is based on the **value chain steps that are based in Peru for the year 2019**. Hence, the scope of the value chain assessment considers the first three steps, as highlighted in orange in the figure to the right.

Several **scoping decisions** have been made within the structure of the value chain to perform the analysis. First, the assessment considers fisher's **income** to be solely from mahi-mahi. Hence, the additional revenue from jumbo flying squid, sharks, and skipjack tuna is out of scope.

Second, the share of profits between boat owners and fishers is assumed to be **50/50**. This has been based on secondary research and input from experts in the fishery.

Third, the analysis focuses on the steps involved in the process of **exporting frozen mahi-mahi**. This means that the value generated at the local market, which involves fresh fish, is not in scope. However, it is important to note that fishermen earn revenue from both domestic and frozen produce – which is accounted for in this assessment given that it is assumed that fishers sell the landed product for the same price at port, regardless of the market[2].

Lastly, it is assumed that **Paita, Pucusana and Ilo** represent the fishery in Peru. This is a reasonable assumption as they are 3 of the largest landing ports and constitute the port of origin of the majority of the mahi-mahi fleet. The Appendix includes a list of assumptions that justify the final scope.



[2]This assumption is based on lack of different pricing data between end markets. However, it is important to note that the price received by fishers when sold to processing plants is usually higher than to local markets due to higher quality of the fish.

METHODOLOGY AND APPROACH 2. DATA COLLECTION

Secondary data collection has followed a data hierarchy to select the most fitting source for a specific data point

When sourcing secondary data, the goal is to use sources with a similar scope to the research being conducted.

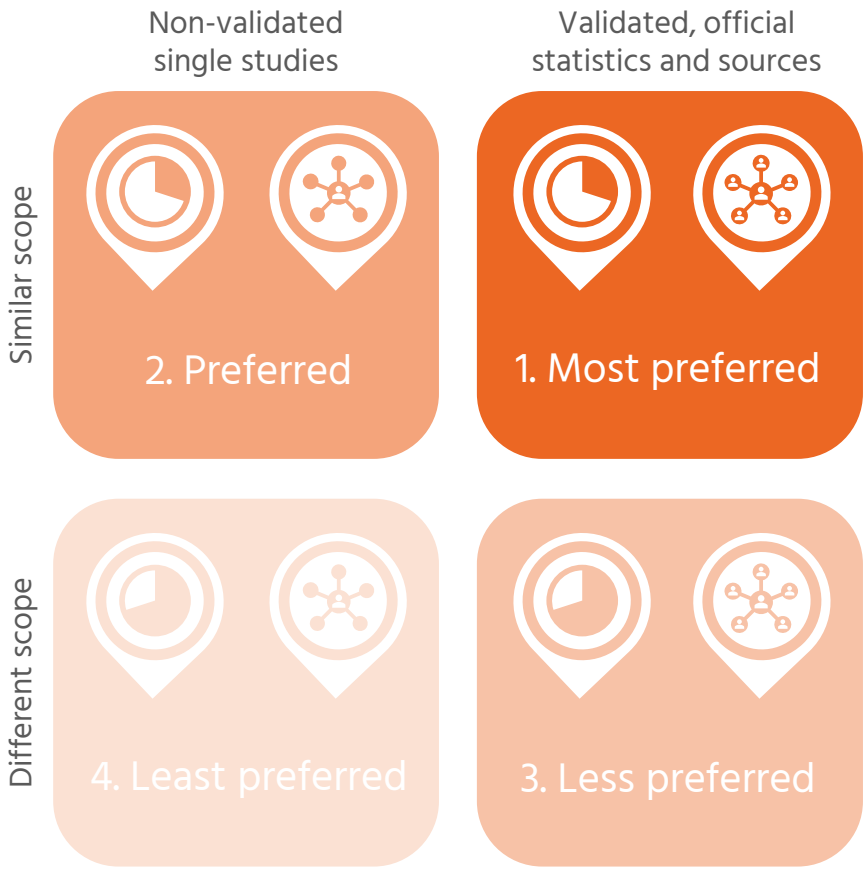
It can happen that, for a given data point, there is **no available data with a similar scope** to the research being conducted.

A **data hierarchy** provides the user with a ranking of data characteristics in order to decide which data point is best suited for the variable at hand. This can be visualized in the matrix to the right.

Examples of scope differences include:

Geographical scope

Time period



METHODOLOGY AND APPROACH 3. MODEL BUILDING (1/2)

A financial model has been developed to capture the value generated at each step of the value chain

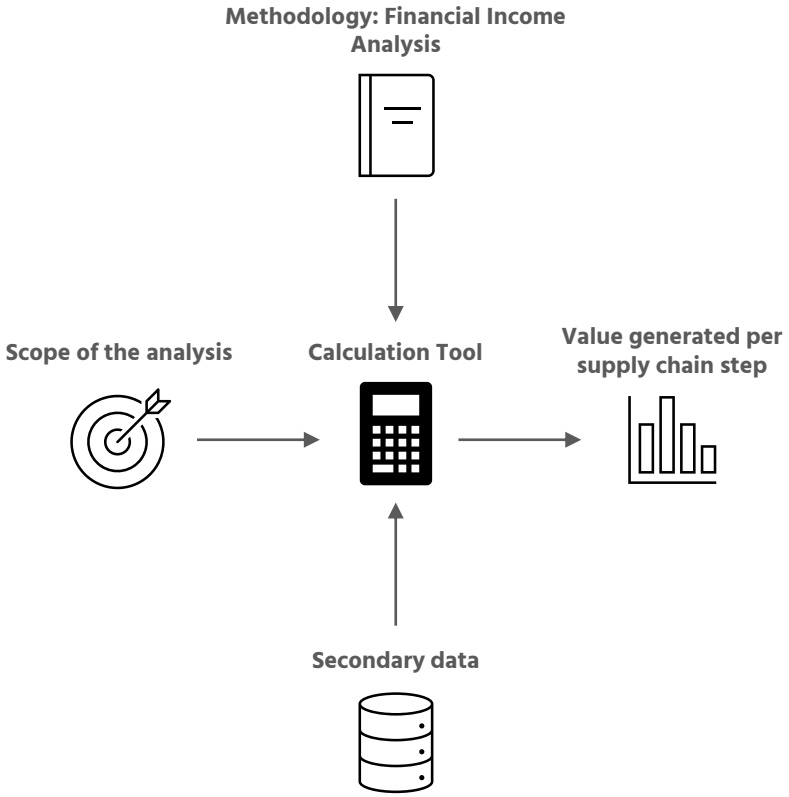
The model was developed based on a **financial analysis to determine the value generated at each step of the value chain**, from fishers to processors.

The focus has been set on the revenue and expense level of each player in the chain. The income analysis is intended to **determine the amount of profit earned at each node** of the value chain. This amount of profit is the value generated. The basic equation used is Profit = Total Revenue – Total Cost, in which profit is obtained when Total Revenue > Total Cost.

For fishers, this analysis has been carried out separately between three different ports: Paita, Pucusana and Ilo. While we are aware that port of origin and landing port are not always the same, this report treats them as such to enable analysis. Further, the total sales price of landed MM in the year of analysis, 2019, is the total revenue of a fisherman. In other words, no other source of income has been included due to data availability.

The initial assessment consisted of calculating the value generated per value chain step. The output of this step was the profit earned in $ / kg of landed MM at the fisher and middlemen level and $ / kg of average final product MM at the processor level. The landed product is the original, whole (but gutted) fish while the final product can be anything from frozen filets to steaks. To be able to compare these outputs, the value generated at the fisher and middlemen level is **adjusted with a quantity ratio** that captures the proportion of the landed MM in the average final product. All final results show the value generated in $ / kg of final product, which is the average of all different kinds of frozen MM products exported.

The following image shows the main processes behind the model development:

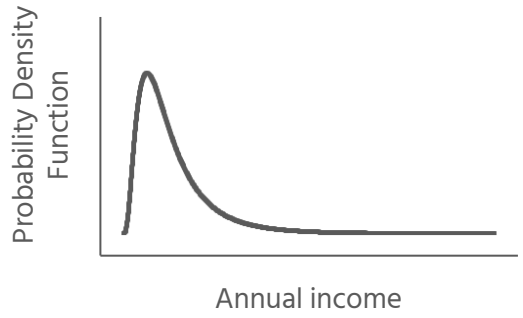


METHODOLOGY AND APPROACH 3. MODEL BUILDING (2/2)

A fishermen income distribution has been used to estimate the underearning present in the MM industry

To determine the presence and size of underearning, the **income distribution at the fisher level was estimated**. This was conducted with a tool that modeled the distribution of fisher income based on secondary data.

Income distributions are usually estimated using a common model: the **lognormal distribution** (Schield, 2018). This distribution describes the complexity of the financial situation of a given population by visualizing the income shares. The shape of the lognormal distribution is characterized by creating a **right-skewed curve**. This fits the income distribution given that the highest share of a given population earns little whilst only a minimum share earns a lot. So, the lognormal distribution highlights the income inequality as seen in the following graph:



This analysis serves to visualize the share of MM fishers that earn below the average income and living income benchmarks. The average income used to provide the income distribution is the estimated value resulting from the financial model explained on the previous page. No studies were found on the living income benchmarks for Peru; hence, the cost-of-living data was taken from living wage studies as the best estimate. Since only the time spent fishing mahi-mahi is in scope, and that period is only 7 months, annual living wage was scaled to that period.

There are several parameters that determine the shape of the log normal distribution. The most important parameter is the mean to median ratio. Impact Institute has tailored this methodology by combining large data sets of incomes and wages from various sources, including datasets from smallholder farmers as well as from the OECD. In particular, the average mean to median ratio applied in our income distribution assessments is 0.80. IN essence, this ratio is an indicator of inequality and material well-being.

With this ratio, it is possible to provide an estimation of the median net income of fishers, given the average income that results from the financial model explained in the previous page. For more information on income distribution and mean to median ratio, please refer to the working paper by the Center for Global Development (2015).

METHODOLOGY AND APPROACH 4&5. ANALYSIS, VALIDATION & REPORTING

The developed model has been utilized and validated with results representing the basis for this report

The **analysis** has drawn upon the model built from secondary sources and expert input to create a detailed, thorough, and robust overview of the value distribution of the Peruvian mahi-mahi fishery in 2019. Once the model has been developed, the data helps to illuminate where, why, and how value accumulates, as well as to what extent mahi-mahi fishermen in Peru are able to earn a living income. The analysis has focused solely on the steps of the value chain occurring within Peru in 2019.

Once the analysis has been completed, the model and results undergo **multiple rounds of validation**, both internally with expert consultants at Impact Institute and externally with Peruvian mahi-mahi fishery experts from WFF's partner organizations. These validation rounds serve to ensure that all data points are accurate, utilized correctly, and most importantly, make sense for the reality on the ground.

The final step has been to **develop the report**, with the purpose to clearly answer the research questions set out at the beginning of the process, as well as to achieve the three goals related to those research questions, as displayed to the right. WFF and Impact Institute are pleased to share the results.

Research questions

1. How does the value of fish accrue through the supply chain?
2. What is the fishers' share of the final product?

Goals

1. Identify the value distribution per supply chain step for the selected fisheries.
2. Determine the presence of underearning faced by fishermen.
3. Understand the role of sustainable fishing in the value distribution of fish supply chains.

Results

03

Photo credits: Yawar Films/ WWF Perú

RESULTS INTRODUCTION

The results of the value chain assessment are presented per goal of the analysis

The following chapter portrays and discusses the results of the Peruvian mahi-mahi supply chain assessment for the year 2019. As previously mentioned, the value chain steps in scope are bound to the operations in Peru: Fishers, Middlemen and Processors. Based on the research question, three main goals were set for the analysis:

- **Goal 1**: To identify the value distribution per supply chain step for the selected fish supply chains;
- **Goal 2**: To determine the presence of underearning faced by fisherfolk and quantify if present; and,
- **Goal 3**: To understand the role of sustainable fishing in the value distribution of fish supply chains.

Goal 1 shows the results of the two main research questions:

1. How does the value of fish accrue throughout the supply chain?
2. What is the fisher's share of the final product?

Goal 2 shows the income distribution at the fisher level in order to visualize the degree of underearning present in the MM industry.

Goal 3 explains what is needed in further studies to successfully complete the analysis.

RESULTS GOAL 1: VALUE DISTRIBUTION (1/4)

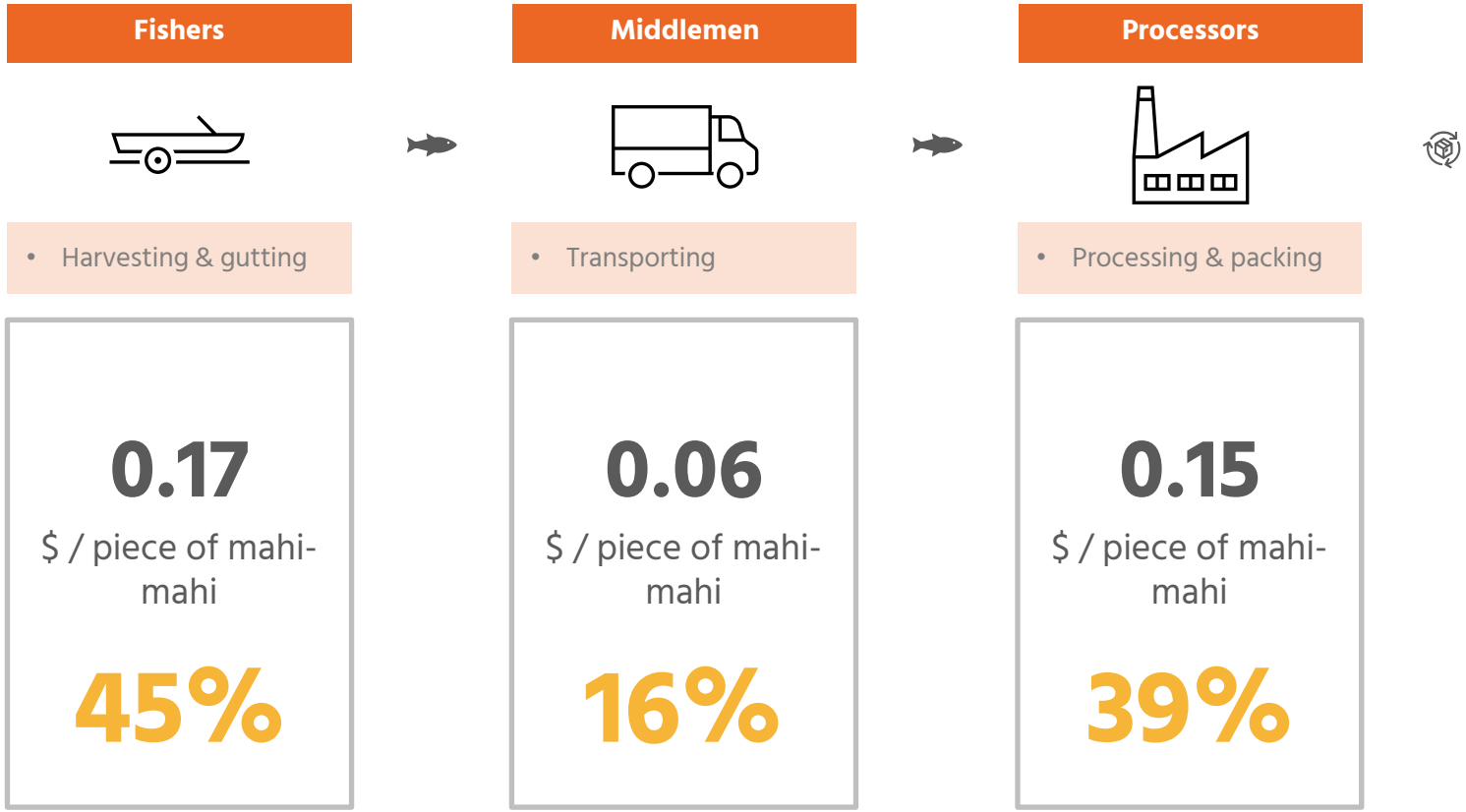
How does the value of fish accrue throughout the supply chain?

From the harvesting of mahi-mahi to the gutting and de-boning, the value of the fish varies as more processes are added to the supply chain. Taking as a reference a typical final product sold at the end market[3], such as a piece of skinless filet, fishers **make a profit of $0.17 per piece**. While middlemen earn $0.06 per piece, processors earn $0.15 per piece. This adds up to a total of $0.38 per piece being retained in Peru.

In relative terms, this means that 45% of the value of a frozen mahi-mahi filet is earned by fishermen. The share for middlemen is approximately 16%, while the share for processors is almost 39%.

While there are between two and three thousands of fishers, there are hundred of middlemen and around 30 processing plants.

Value Chain Step



[3]The end market is the final retailer in the international value chain (e.g.: Supermarkets in the USA). The average price at the end market of $4/skinless filet may be compared to an average 2019 export price of $6.41 per kg of final product.

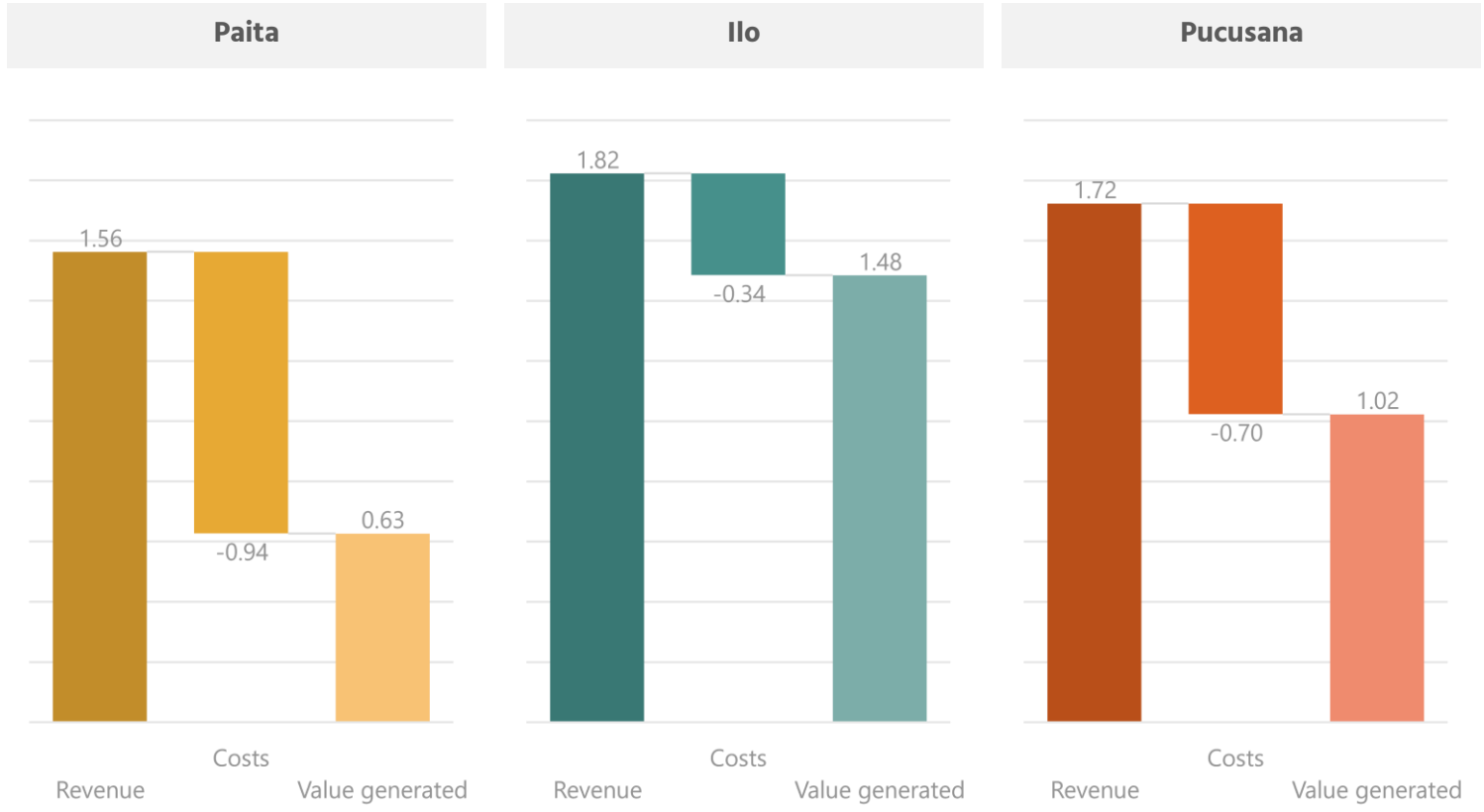
RESULTS GOAL 1: VALUE DISTRIBUTION (2/4)

The net income breakdown shows at the fisher level is highly dependent on port. Paita provides the lowest profit margin per kg whilst Ilo provides the highest

The graphs to the right display the net income breakdown for **fishers per port** analyzed in this assessment. Paita fishers have the lowest net value, $0.63 per kg of landed mahi-mahi; Ilo fishers have the highest net value, $1.48; whilst Pucusana fishers have a net value of $1.02.

Selling prices have been extracted from the IMARPE database, which includes daily prices per port and type of fish. In particular, revenues are $1.82 and $1.72 per kg of landed mahi-mahi in Ilo and Pucusana, respectively; whilst Paita fishers have an average revenue of $1.56. Costs per kg at Paita are almost three times higher than in Ilo. It is important to take into account the number of boats and total volume of landed mahi-mahi that each port is responsible for. The next page will discuss this in more detail.

Net income breakdown per port, 2019. Units: $ / kg landed mahi-mahi



RESULTS GOAL 1: VALUE DISTRIBUTION (3/4)

Exploration of net income differences across ports

The previous page displayed the net income per kg of landed mahi-mahi, in which Paita had the lowest value. However, this port has the largest number of trips per boat, which is evidenced in the high average yield per trip. In turn, this means that, despite high costs per trip and crew size, Paita fishers have an average yearly income of $4,314. This income is greater than that in Ilo and Pucusana, with an average yearly income of $3,974 and $2,025, respectively.

The data point of number of trips per boat per year determines the average yearly net income. It is important to note that this data point has been extracted from an expert professional on the field. This is because no data was found, and the estimated values were considered not to be representative. For that reason, the data points included are assumed to represent the reality on the ground as per the input from an expert.

Main descriptive per port

	Paita	Ilo	Pucusana
Number of trips per boat per year (#)	12	8	8
Crew members per boat per trip (#)	8	5	5
Trip costs ($ per trip)[4]	7,954	1,693	3,500
Yield (kg landings per trip)	6,878	2,676	1,978
Average yearly net income ($)	4,314	3,974	2,025

[4]The costs per trip are extracted from a WWF report (2017a) and adjusted for inflation and exchange rate.

RESULTS GOAL 1: VALUE DISTRIBUTION (4/4)

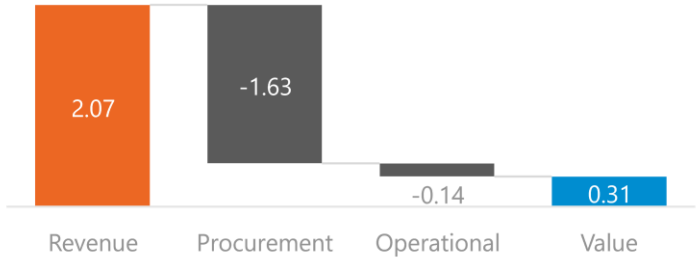
The net income breakdown at post-harvesting value chain steps shows that processors retain a higher margin as compared to middlemen

The role of the **middlemen** is diverse – they purchase landed MM from fishermen, transport them by refrigerated truck to processing plants, and sometimes even lend money to fishers to cover operational costs. The costs at the middlemen level include procurement costs (i.e., purchasing costs) and operational costs, which have been estimated based on an academic paper showing average distribution of costs in Peruvian fisheries (Christensen et al., 2013). This results in a net income of **$0.31 per kg of landed product**. This value seems to be too low. However, it is important to take into consideration the volume of mahi-mahi that middlemen manage and their role in the supply chain. Middlemen manage the catch of many fishers and they transport this to the processing facilities.

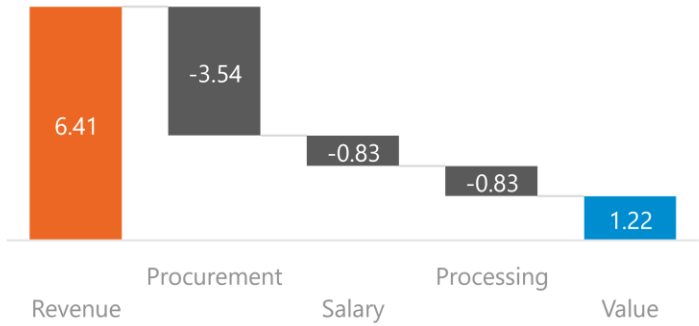
The costs at the processor level include procurement, salary and processing. The latter costs have been estimated based on the same academic paper as previously mentioned (Christensen et al., 2013). The Appendix includes an overview of costs per supply chain step. **Processors** sell their frozen MM for $6.41 / kg of final product, with associated procurement costs of $3.54 / kg, salary costs of $0.83 / kg, and processing costs of $0.83 / kg. This means that they earn **$1.22 / kg of final product.** The value accumulated at the processor step is displayed in USD / kg average final product because the final product exported has been changed significantly from previous steps in the value chain. The final product can be anything from MM steaks, to filets, to "whole" (i.e., only gutted) MM. This adjustment has been made using an average efficiency yield of 59%[5] for an average exported product.

Net income breakdown, 2019.

Middlemen
Unit: $ / kg landed product



Processors
Unit: $ / kg average final product



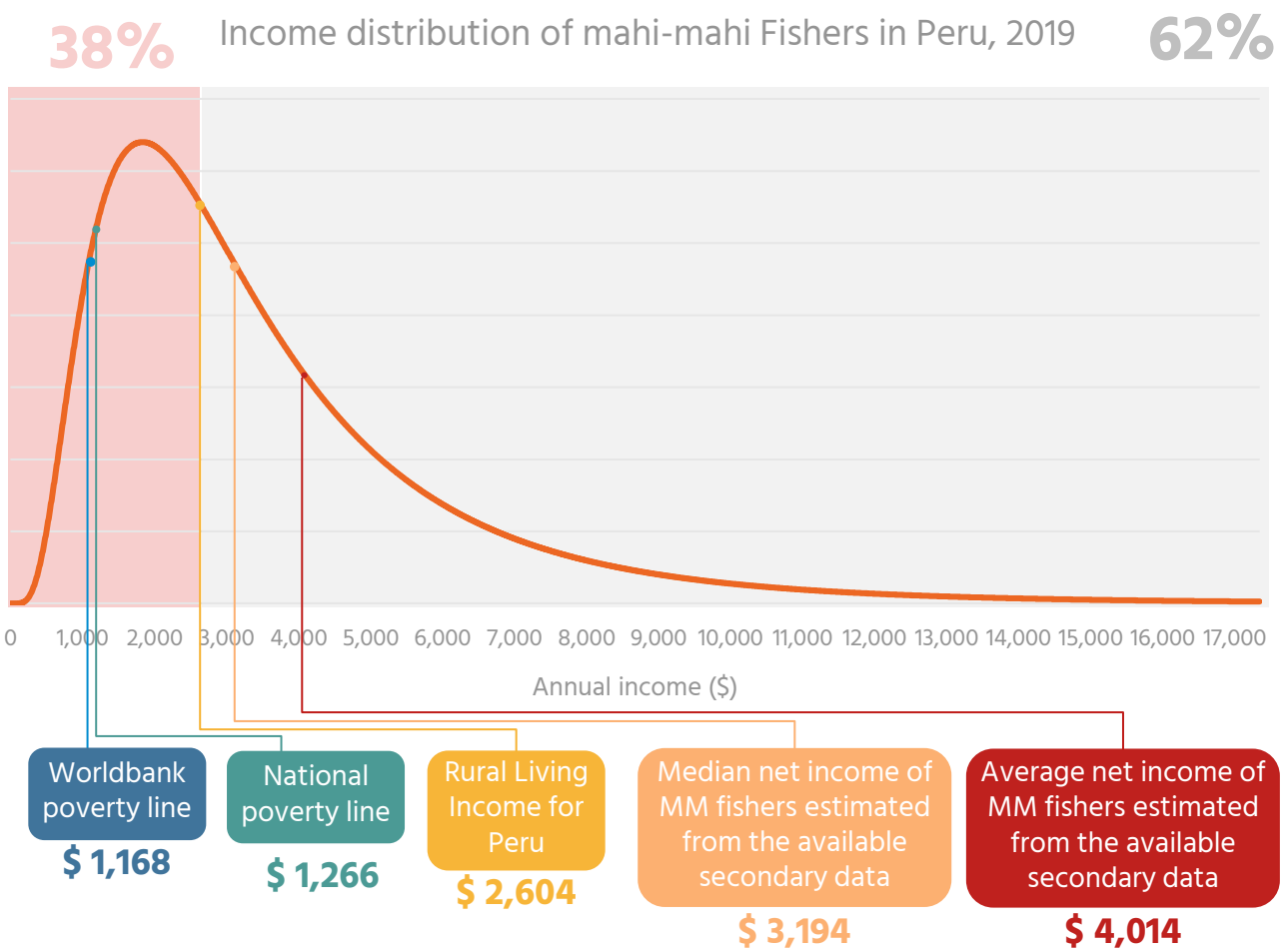
[5]The efficiency yield represents the utilized part of a fish, that is, the "cleaned" product after all processes have been applied. It is calculated by diving the final weight of the product and the original weight of the fish.

RESULTS GOAL 2: PRESENCE OF UNDEREARNING

An estimated 38% of mahi-mahi fishers live below the living income for Peru

The average net income of MM fishers, estimated with the financial model developed for the purpose of this study, results in $4,014 per year. Based on the methodology applied in the net income distribution, the estimated median is $3,194 per year. Median values are more representative since the average is very likely skewed by a few large earners in the fishery.

The graph displayed here shows the net income distribution for MM fishers. Both the average and the median net incomes are above the living income[6] in Peru. However, still an estimated **38% of MM fishers earn below a rural living income**. The MM fishery is known to be high-risk, high-reward; meaning that the expected revenue per trip is high, reason for which fishers accept the risk of going to sea for many consecutive days. In fact, there are migrant fishers that join one or two trips searching for the high compensation that the fishery is known to offer.



Paita
4,314

Ilo
3,974

Pucusana
2,025

Average net income per port per season ($/year)

[6]The rural living income was calculated by multiplying the monthly living wage ($372) by the length of mahi-mahi season (7 months) to yield an "annual" living income ($2,604) representative for the duration of the season.

RESULTS GOAL 3: ROLE OF SUSTAINABLE FISHING

The lack of available data on sustainable fishing in the MM industry did not allow to understand the role of sustainable fishing in the value distribution of the MM supply chain

The lack of data availability on sustainable indicators has not allowed for this analysis to be conducted. In particular, lack of monitoring and oversight, the informality of the sector, and lack of attention to artisanal fisheries vs industrial fisheries at a governmental level were identified as obstacles to the adequate evaluation of sustainable MM fishing in Peru.

However, insights into the fishers' income, which is one element of the scope of sustainable fishing, have been possible to portray, as discussed on the previous page.

To successfully analyze the role of sustainable fishing in the value distribution of the MM supply chain, it is **recommended to include questions of sustainability in other MM studies.** This will push for raising awareness in the industry regarding the lack of data in terms of sustainable harvest and monitoring of compliance.

It has also been noted that there is a general lack of governmental oversight in regard to artisanal fisheries in Peru. It is **recommended that future governments create long-term national plans** that better regulate and monitor the MM fishery. Further, it is **recommended that efforts to promote adherence to new and existing legislation are strengthened** through, for example, increased funding and incentives for actors to comply.

Scope of sustainable fishing

(i) Fishing that occurs at a level at which fishing can continue indefinitely and the fish population can remain productive and healthy

(ii) Fishing that minimizes environmental impact through proper ecosystem management

(iii) Fishing that is managed effectively

(iv) Fishing that allows fishermen to earn living incomes or be paid living wages and human rights violations to be eliminated.

Discussion

04

Photo credits: Yawar Films/ WWF Perú

DISCUSSION OVERVIEW

While there is some underearning in the fishery, fishers typically make a living income

Based on the research in this report, **fishers receive approximately 45%** of the value of a landed fish while middlemen and processors receive 16% and 39% respectively. This relative shares illuminate the value accrued per kg of portion of mahi-mahi. The average fisherman handles far less volume than middlemen or processors. There are likely a few thousand fishermen, perhaps a few hundred middlemen, and around 30 processors – with each value chain step dividing value accrued at that step by number of actors. Consequently, when displaying fishermen income in terms of final product, the value seems high; however, in reality, the yearly income of rural fishermen in Peru remains low.

As previously mentioned, the mahi-mahi is a high risk, high reward fishery. While costs of fishing can be high, owing to both the migratory nature of mahi-mahi and their distance from shore, the thriving United States bound export market supports the fisheries attractiveness. This can be seen in the results, where the average fisher from both Paita and Ilo makes well above the rural living wage during the fishing season. Fishermen from Pucusana seem to earn less – on average $2,025 USD/year. The immediate reason for this can be seen in the cost per trip to yield ratio – an average fishing trip from Pucusana requires twice the cost as one from Ilo while profiting from less yield. This does not necessarily imply that fishers from Pucusana are the poorest, but rather that fishers from Pucusana seem to earn the least **from the mahi-mahi fishery**. This is a reflection of the scope of the assessment, which only analyzed income derived from the MM fishery. However, MM fishermen join other fisheries, particularly outside of MM season. Consequently, including the revenue gained for fishers that catch jumbo flying squid, sharks, and skipjack could add useful context to living income and underearning calculations. While this was out of scope for this assessment, future studies of these value chains would be valuable.

Finally, the value distribution results of this analysis are limited to the steps of the value chain present in Peru. As a recommendation for future research, it would be interesting to determine how the value accrues **from fisher to end consumer**. This would serve to highlight what step in the supply chain is accruing the most, by comparing local (i.e., processors) to international steps (i.e., retailers).

DISCUSSION RECOMMENDATIONS (1/2)

38% of MM fishers earn below the living income. Several approaches are recommended to contribute to closing the gap

The goal of this research was to get a better understanding of the way value accrues in the value chain, and particularly how fishers fare. Current results indicate that, taking into account the median and average values of net income, mahi-mahi fishers earn above a living income. However, just because not all mahi-mahi fishers are in a state of strict financial poverty, does not necessarily indicate that they have a high quality of life. This is highlighted by the fact that an estimated 38% of MM fishers earn below a living income. While this research has been based on secondary data, the collection of primary data regarding fisher income in future research would allow for more tailored analyses in regard to the main income drivers, which mainly include yield, price and costs. With the data and results from this study, it is recommended to **move towards a living income by closing the living income gap** through:

1. **Fair and sustainable pricing.** There are several pricing methodologies that highlight what price would account for environmental and/or social costs. These approaches have also proven effective when engaging consumers via marketing and branding activities. Fairtrade has developed a methodology named Living Income Reference Price (LIRP). This is an approach used to capture the price that would allow an individual to earn a living income from their economic activity. Hence, its implementation would enable the comparisons between the price received by fishers and a universal reference benchmark that would guarantee a living income. This would determine the fairness of current pricing dynamics and would stimulate a push for change in the industry by increasing transparency and creating change. Please see the bibliography for more information on the LIRP (Fairtrade, 2019).
2. **Include socio-economic considerations**. It is recommended to apply multifaceted understandings of poverty that combine financial and socio-economic considerations. For example, as revealed through expert interviews, migrant fishers (often Venezuelan) frequently endure worse work and safety conditions due to their immigrant status. In particular, these migrant fishers often join one or two trips expecting a high compensation. The economic needs of this group are drastically different than the average local fishermen. More nuanced understandings of poverty and wellbeing should include conceptions of equity and power structures, as disempowerment and poverty frequently go hand in hand.

DISCUSSION RECOMMENDATIONS (2/2)

Involving the government and increasing data collection activities is key to improve the understanding of the fisher's income

Further, the following recommendations are provided to capture the whole value chain and its complexities and needs:

1. **Long-term planning and improved monitoring at the governmental level.** Secondary research indicates that one of the main issues stakeholders experience is a lack of clarity and continuity in government policy and planning. High turnover rates in relevant governmental agencies, as well as a tendency to prioritize the maintenance of industrial fishing over artisanal fishing (owing, for example, to the Peruvian anchovy fisheries' historical importance) have created inconsistency in policy and oversight. This is reflected in the way that fishery statistics are collected and organized, which makes it challenging to undertake rigorous financial value analysis. Improving monitoring of certain data points, in particular port of origin versus port of landing and number of trips taken per boat, would allow for a more in depth understanding of the way value accrues in the mahi-mahi value chain, and particularly allow for a more nuanced understanding of fisher income.

2. **Continue promoting data gathering and data accuracy improvement measures.** A financial value analysis is only as good as the data it utilizes. Illegal and unreported fishing remains a problem within not only the mahi-mahi fishery, but many fisheries globally. A more formalized, organized, and standard fishery allows for improved management possibilities.

3. **Formalization of mahi-mahi fleet and improved monitoring.** Several key assumptions (found in the Appendix) had to be made based on secondary data, ranging from number of boats in the fishery to average catch per boat. In order to improve the accuracy, relevance, and clarity of results, it is recommended that efforts are made to increase artisanal fisher registration and improve monitoring systems such that more informed decisions can be made with the goal of sustainable fishery management.

Assumptions and Limitations

05

Photo credits: Yawar Films/ WWF Perú

ASSUMPTIONS AND LIMITATIONS

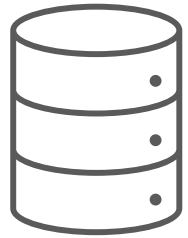
The analysis has been conducted with various limitations in data collection and data accuracy. This has necessitated the making of assumptions for use of available data

The data used to produce the value chain assessments has not included primary data collection. Hence, the focus on living income and expenses at the fisher's level has been limited by data availability. This has had different implications, as listed below.

First, strong assumptions have been made to maximize the usefulness of available data points and estimate missing values where needed. For instance, cost data at both middlemen and processor level has been estimated using average cost structures from Peruvian fisheries. Used values come from "middlemen freezing" and "freezing plants" from academic paper Christensen et al. (2013).

Further, given the lack of data in terms of sustainable fishing activities, this analysis has not been able to include the role of sustainable practices in the overall value distribution of the supply chain. As stated previously, it is recommended to stress the importance of collecting data in this regard to be able to conduct relevant analyses.

Detailed assumptions are listed in the Appendix.



No primary data availability

Lack of sustainable indicators

Appendix

- *Cost overview per value chain step*
- *Key assumptions per value chain step*
- *References*

06

Photo credits: Yawar Films/ WWF Perú

APPENDIX COST OVERVIEW PER VALUE CHAIN STEP

The following table provides an overview of the different cost types included per value chain step

	Cost overview per value chain step		
Type of data	Fishers	Middlemen	Processors
Data value	Cost per trip (LCU/trip) per province in scope (Paita, Ilo, Pucusana) Source: WWF (2017a)	Procurement costs (selling price of fishers) Source: IMARPE database	n.a.
Estimation	n.a.	Cost of inputs: 85% of total revenue Source: Christensen et al. (2013)	Cost of inputs: 68% of total revenue Costs of salaries: 13% of total revenue Source: Christensen et al. (2013)

APPENDIX KEY ASSUMPTIONS FOR FISHERS (1/2)

Data point	Current treatment/assumption	Rationale	Value
Ports in scope (Paita, Ilo, Pucusana)	• It is assumed that the mahi-mahi landings in Paita, Ilo and Pucusana are representative for Peru as a whole	• This is due to the fact that the majority of boats have these locations as home ports	
Catch per trip Paita, Ilo, Pucusana	• Data point from 2015 represents scenario for 2019 and adjusted with % per port	• Lack of data for 2019	Paita: 8,500 kg landed product/trip Ilo: 5,000 kg landed product/trip Pucusana: 5,000 kg landed product/trip
Cost per trip Paita, Ilo, Pucusana	• Data point from 2015 is inflated to scenario for 2019	• Lack of data for 2019	Paita: 7,954 USD/trip Ilo: 1,693 USD/trip Pucusana: 3,500 USD/trip
	• Costs of extraction are assumed to be costs of fishing gear, fuel and bait	• Not specified in the source used, assumption based on expert knowledge	
Number of trips per boat per year	• Data points filled in with expert input due to data availability	• Lack of data for 2019 • Assumed based on expert knowledge	Paita: 12 trips/boat/year Ilo: 8 trips/boat/year Pucusana: 8 trips/boat/year
Crew size Paita, Ilo, Pucusana	• Data point from 2015 represents scenario for 2019	• Lack of data for 2019	Paita: 8 fishers/boat Ilo: 5 fishers/boat Pucusana: 5 fishers/boat
	• It is assumed that boat owners are not part of the fishing crew	• Assumption based on expert knowledge	

APPENDIX KEY ASSUMPTIONS FOR FISHERS (2/2)

Data point	Current treatment/assumption	Rationale	Value
Other sources of income (when not fishing from May – Sept)	• No other sources of income are included in the assessment. Hence, the only source of income included is the stream from the mahi-mahi fishery	• Mahi-mahi fishermen fish for jumbo flying squid, shark, and skipjack tuna in other months of the year, but this is out of scope due to data availability	
Number of boats equipped with longline fishing for mahi-mahi	• Data point from 2017 represents scenario for 2019	• Lack of data for 2019	2,141
Share of profits for fisherman	• It is assumed that boat owners receive 50% of the profits and fishermen share the other 50% of the profits equally among the crew	• Assumption based on input from experts in the fishery. Important to mention that it does not differentiate between captain and crew	50%
Selling price	• It is assumed that the selling price to the local market is the same as the selling price to the processing plants	• The price can indeed vary based on end destination since the quality of the product is higher when it is sold for export. However, this assumption was made due to lack of data availability to distinguish between both markets and with expert input	

APPENDIX KEY ASSUMPTIONS FOR MIDDLEMEN

Data point	Current treatment/assumption	Rationale	Value
Total costs as a percentage of the total revenue	• Data point from 2009-2012 represents scenario for 2019	• Lack of data for 2019	85%
	• Data point from artisanal fisheries 'middlemen freezing' in Peru is representative for mahi-mahi middlemen • This % is based on artisanal fisheries 'middlemen freezing' in Peru	• Lack of specific data for mahi-mahi fisheries • Mahi-mahi is an artisanal fishery
Other costs	• Currently estimated using the cost structure of 'middlemen freezing' in Peru as mentioned above	• Data point missing	
	• Other costs are assumed to be costs of ice, fuel and certificate of origin	• Not specified in the source used, assumption based on expert knowledge	

APPENDIX KEY ASSUMPTIONS FOR PROCESSORS

Data point	Current treatment/assumption	Rationale	Value
Total costs as a percentage of the total revenue	• Data point from 2009-2012 represents scenario for 2019	• Lack of data for 2019	81%
	• Data point from artisanal fisheries 'freezing plants' in Peru is representative for mahi-mahi processing plants • This % is based on artisanal fisheries 'freezing plants' in Peru	• Lack of specific data for mahi-mahi fisheries • Mahi-mahi is an artisanal fishery	
Costs of labor	• Currently estimated using the cost structure of 'freezing plants' in Peru as mentioned above	• Data point missing	
Costs of processing	• Currently estimated using the cost structure of 'freezing plants' in Peru as mentioned above	• Data point missing	
	• Costs of processing are assumed to be water electricity, equipment and rent	• Not specified in the source used	
Costs of production	• Currently estimated using the cost structure of 'freezing plants' in Peru as mentioned above	• Data point missing	

APPENDIX KEY ASSUMPTIONS FOR ALL

Data point	Current treatment/assumption	Rationale	Value
Rejection rates	• Rejection rates are not included in the current calculations	• According to expert advice, fish that are rejected for export can still be sold on the local market for the same price – consequently, rejection rate does not affect fishermen revenue or profits	
Average mahi-mahi yield between value chain steps	• It is assumed that there is no efficiency loss from fishers to middlemen	• This is because we assume there is no change in weight of mahi-mahi catch from fishing to transporting by middlemen	100%
	• The average % of yield at the processor level is adjusted based on the loss of yield of mahi-mahi before and after processing into final product	• This is conducted to take into account the change in the weight of the mahi-mahi during the treatments and/or processes applied to the product	59%
	• Data point from 2014 represents scenario for 2019	• Lack of data for 2019	

APPENDIX REFERENCES

The following is a list of references consulted to perform this analysis

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