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# What is at risk due to informality? Economic reasons to transition to secure tenure and active co-management of the jumbo flying squid artisanal fishery in Peru

Renato Gozzer-Wuest [a,*], Enrique Alonso-Población [a], Stefany Rojas-Perea [a], Rubén H. Roa-Ureta [b]

[a] Programs Division, Sustainable Fisheries Partnership, Honolulu, HI, USA
[b] Independent Consultant, Bilbao, Spain

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ABSTRACT

The Peruvian artisanal squid fleet accounts for more than 45% of the worldwide landings of the jumbo flying squid (JFS) fishery, the largest invertebrate fishery worldwide. Nevertheless, most vessels involved in the fishery lack secure tenure rights and operate within the informal economy. Interviews and a survey directed to ship-owners allowed identification of three economic regimes under which the fleet operates and estimation of annual operating costs, revenues, and added value. Our results show that the fishery has high economic importance in Peru, accounting annually for 9–15% of the total Peruvian fisheries sector's GDP. Even during 2020, highly impacted by the COVID-19, the fishery was profitable and maintained economic accounts not substantially below of previous years. Furthermore, public data on landings and off-vessel and export prices were used to model the impact of supply on price elasticity for fishers and exporters in Peru and Chile. Data showed steep declines in off-vessel prices with increasing supply for Peruvian fishers. Conversely, Peruvian exporters and Chilean fishers and exporters mostly retained stable prices at nearly all supply levels. The paper suggests that the informal status of the Peruvian JFS fishing activity, which lacks co-management mechanisms, is amongst the co-factors explaining the different price elasticity suffered by the Peruvian fishers. In view of the results, we suggest that speeding up the granting of secure tenure rights to the acting operative artisanal fleet and prompt development of co-management arrangements has the potential to bring environmental and economic gains for fishers.

## 1. Introduction

The jumbo flying squid (JFS) fisheries along the East Pacific coast are the largest invertebrate fisheries worldwide, and the Peruvian JFS fishery is the largest among these, accounting for 47% of the total landings in volume [1], over 500 thousand tonnes in 2019 [2]. In Peru, the fishery was worth close to 850 million USD in exports in 2019 [3], contributing substantially to the income of entire fishing communities as well as domestic consumption [4]. While the fishery yields large production volumes, it is exclusively operated by an artisanal fleet [5] composed of thousands of small boats (< 15 m in length) operating with low technology equipment [6]. Official data shows that between 2010 and 2019, the JFS fishery represented 38% of all Peruvian landings destined towards direct human consumption and 59% of the total value of the seafood exports for direct human consumption.

Small-scale fisheries have been characterized as inherently diverse, complex and dynamic, facing wicked and multi-dimensional challenges that lead to poverty and widespread vulnerability [7]. Amongst the multiple ramifications of the poverty-vulnerability interdependencies, the institutional dimensions have been identified as of crucial importance [8], both in Latin America [9] and elsewhere (see [8]). Despite its economic relevance and contribution in terms of export revenues, income and food security, weak institutional support to the Peruvian artisanal squid fleet poses a number of risks. Specifically, the fishery is burdened by a number of policy issues that preclude realizing its full potential contribution to local communities and the national economy at large. Principal among these is that fishing operations are conducted as an informal economic activity [10–13]. This informal status is

* Corresponding author.
*E-mail address:* renato.gozzer@sustainablefish.org (R. Gozzer-Wuest).

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widespread amongst small-scale fishers in Peru [14–17] and affects many other economic sectors in country, as revealed by the fact that 50%[1] of the total small enterprises, 70% of the economically active population [18,19] and one-fifth of the Peruvian gross domestic product (GDP) [20] reportedly operate within the informal economy.

A first policy issue is the lack of secure tenure rights hindering sustainable use, as the fishery remains *de facto* open access (see [21,22]), like most small-scale fisheries in country [23,24]. Since 2016 the government has launched programs to legalize the active operating fleet through both individual[2] [13,25] and collective[3] rights regimes. These programs had a slow progress [26] and yielded limited outcomes [27]. Furthermore, the coexistence of different tenure regimes had the effect of sharpening the tensions within the sector, hindering the required collective action to address fishery related issues (see [28]).

Second, many of the vessels operating in the fishery were built in local artisanal shipyards with irregular legal status, and the building of new vessels continues to occur outside the legal framework [16,23,25,29,30]. Third, oftentimes, the relationship between fishers and ship owners is also informal [31], leading to the engagement of unqualified seafarers and circumventing social security, accident, and health insurance payments and benefits. Vulnerability of workers, specially of groups at risk of social exclusion such as migrants employed the fishery [32], worsened amidst shocks such as the COVID-19 pandemic (see [33,34]). Fourth, informality hinders the capacity of vessel owners to access credit from banks and formal credit institutions, leading to reliance on informal moneylenders. Fifth, while the fishing activity is carried out informally, the post-harvest and marketing side of the supply chain up to the exporters operates within the legal framework, potentially introducing asymmetries in bargaining power.

Sixth, fishers routinely swamp the market due to a lack of effective organization and knowledge of market dynamics. Episodic oversupply generates cyclical social tensions from abrupt drop-downs in squid prices [35,36] and facilitates the rise of an illegal squid market for fishmeal [37–39]. Seventh, a significant part of the exports goes to the European market, where measures to combat Illegal, Unreported, and Unregulated (IUU) fishing can be directed against the Peruvian JFS fishery [25]. The United States International Trade Commission has recently raised concerns in this regard [40]. These types of measures may bring along further unfair outcomes to fishing communities [41].

Exports of Peruvian JFS have nearly doubled its revenues in the last few years [11]. However, the scarce specific economic information at the landing level has hindered knowing the increasing importance for the local Peruvian small-scale fishing communities' economies and the need to accompany this growth with management efforts commensurate to a large volume artisanal fishery like this. This work describes and evaluates the Peruvian JFS fishery's economic results to determine its importance and contribution to the Peruvian fisheries sector and identify some economic inefficiencies likely to result from its institutional fragility. We aim to help the transition of the Peruvian JFS fishery from an informal activity to an institutionally recognized, co-managed fishery.

## 2. Methodology

### 2.1. Data

We extracted Peruvian JFS landings data by month between January 2016 and December 2020 from the Ministry of Production [42–44] and Peruvian off-vessel pricing data over the same time range from the Peruvian Marine Research Institute [45]. These prices were standardized to January 2016 using official inflation data [46,47]. Data on the various operational and financial costs, as well as taxes and revenue allocation, were not available as open-source data. Therefore, after carrying out four semi-structured interviews to experienced ship owners with an average of 16.5 years operating in the JFS fishery, we collected primary data by conducting surveys to ship owners operating in the fishery. The questionnaire included 44 quantitative and 12 qualitative variables necessary to estimate various costs and revenue of the fleet (Supplementary Table SM1).

We determined a stopping rule to receive more information by examining the coefficient of variation of 44 quantitative variables. We stopped collecting data when the coefficients of variation stabilized, with no further gains as more answered questionnaires were received. At that point, we had received 28 answered questionnaires where most quantitative variables had a coefficient of variation of less than 50% (Fig. 1). On average, these ship owners had 18.8 years of experience operating in the JFS fishery, and almost all considered it their main economic activity. It is also important to consider a regional difference between fishers in the north of Peru and those in the south, with the former using larger boats [4]. However, given the voluntary nature of participation in the survey and the difficulty in obtaining highly sensitive commercial information from private vessel owners, our sample of survey respondents turned out to be mainly from the northern fleet (82%). Nevertheless, the northern fleet accounts for nearly 80% of the total catch,[4] so we considered our sample representative enough for the aims of this work.

During the data collection and processing, ethical considerations were carefully taken. Responding to the survey was voluntary. None of the participants were pressured or coerced to participate, and we asked for a statement indicating informed consent to participate before proceeding with the survey. The purpose of the survey and how the data would be used was explicitly explained to participants. Finally, we only used the data for the current study. Anonymity has been fully respected and no personal information has been shared with third parties.

On the other hand, when interviewing the first four shipowners, it was made clear that the fishery does not operate on a single operational and economic regime throughout the year, but instead that there are three regimes as determined by resource availability and economic variables. Answers returned in the 28 questionnaires showed a

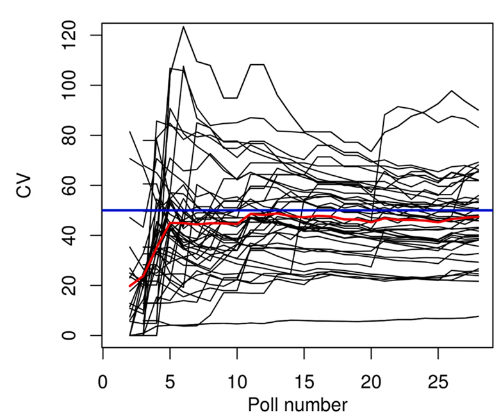


**Fig. 1.** Cumulative percentage coefficient of variation for 44 quantitative variables (displayed as black lines) while poll numbers increased in the survey of costs and revenues of the Peruvian JFS fleet. The red line is the group mean, and the blue line is 50% CV. (For interpretation of the references to colour in this figure, the reader is referred to the web version of this article.)

[1] https://ogeiee.produce.gob.pe.

[2] The Formalization System for Artisanal Fisheries (SIFORPA, for its acronym in Spanish) launched its firsts phase for vessels up to 6.48 gross tonnage (GT) in 2016 and its second one for vessels of more than 6.48 GT in 2018.

[3] Cooperatives program launched in 2016.

[4] Calculated based on the official total landings for the 2019 and 2020.

unanimous agreement by responding to ship owners with the existence of these three intra-season regimes. These regimes are (1) low landings, high price, high fishing effort (in days of fishing), and low resource availability in waters close to the ports; (2) intermediate to low landings, intermediate to high prices, intermediate fishing effort, and low resource availability in waters close to the ports; and (3) intermediate to high landings, intermediate to low prices, low fishing effort, and high resource availability in waters close to the ports. The third regime includes extreme, short periods when the price is so low that ship owners halt fishing altogether even though resource availability is high. Given the importance of these regimes to the fleets' operations, we have structured our descriptive economic assessment by regime.

To test for the impact of asymmetries between Peruvian fishers and Peruvian processors and exporters up the production chain, we gathered additional open-source landings and pricing data of the JFS fishery in Chile. Then we tested for the fall of prices with increasing supply to determine whether Peruvian fishers have less bargaining power than Chilean fishers. We also extracted export volume and price data from both countries to show that this potential anomaly occurs only to fishers and not to processors-exporters. The interest of the Chilean case is of relevance because: a) fishers in Chile conduct their operations within the same legal framework as processors-exporters and as such are recognized by the management authority, b) fishers are well organized under a national fisherfolk organization (*Coordinadora Nacional de Jibieros*) and c) fisherfolks have a strong presence in decision-making bodies recognized by legislation, as among others, they are active participants in a legally recognized co-management committee charged with developing management measures for the fishery (artisanal fishers comprising seven out of the thirteen members). To test the cause-effect links of this co-management arrangement in countering high price elasticity, we reviewed publicly available documents and the minutes of the meetings of the Management Committee and held two key interviews with key informants. Other factors that may affect our contrast between Chilean and Peruvian markets for fishers and exporters, such as the degree of local resource consumption, could not be considered due to the absence of open-source and reliable statistics.

### 2.2. Descriptive economic analysis

Monthly revenues were calculated as the product of monthly landings and monthly average off-vessel price. Operation costs were grouped into three categories: fishing, maintenance, and asset depreciation. Fishing costs included fuel, crew share, ice, food and water, fishing gear, lubricant, pier fees, government certificate of origin, pre-payment of income tax, and financing costs. Maintenance costs included the hull, engines, hold, propeller, electrical/hydraulic systems, painting, dry dock, and financing costs. Asset depreciation costs included the hull, engines, navigation, propeller, and insulation systems.

When calculating the various cost items, we introduced a few assumptions and approximations. We assumed that the unit value of cost items provided by external suppliers was composed of three components: base value, the provider's margin, and taxes (value-added, income, and a fuel-specific tax). In the case of fuel, we used official data published by the Ministry of Energy and Mining [48], while for the other cost items, we assumed 25% of the supplier's margin over the base value. Based on the Peruvian regulations, the value-added tax was set at 18%, and pre-payments of income tax at 1.5%. Pier fees were set at 20 Peruvian soles per tonne of landing and government certificate of origin at 0.0911% per Peruvian standard tax unit[5] (UIT, by its acronym in Spanish) per tonne. The consolidated cost structure (excepting crew share, pre-payments of income tax, and financing of the operation costs) are shown in Table 1.

[5] Between 2016 and 2020, a Peruvian UIT was valued between 3950 and 4300 soles (1100 and 1200 US dollars).

Since the landings and off-vessel price data are grouped by month, we classified each month in the 2016–2020 time series as belonging to any of the three regimes. For this purpose, we used the price data because this time series had a better contrast (higher variation) than the landings time series. Then, other operational variables for the month were set according to the mean value obtained for that regime in the responses to the questionnaire survey. More importantly, for the characterization of the economic outputs, these operational variables were the number of fishing trips per boat per month and the landings per boat per month. Once the classification of each month into one of the three regimes was completed, we calculated the total number of fishing trips, the total number of vessels fishing, and the total fleet-level operational expenses.

The crew share was computed as a monthly percentage of the difference between revenues and fishing costs excepting the crew share, and it was set as the mean over the various percentages given in the responded questionnaires. The remaining percentage was considered to be the income for the shipowner, which after paying income tax, financing and maintenance costs, and depreciation, results in the net operating profit.

Peruvian artisanal fishing activities usually do not have access to the banking system, so we estimated financing costs using the usual interest rates within the informal Peruvian economy. Therefore, we assumed that the effective annual cost of financing was 270%, which corresponds to the mean estimate of mortgage-backed informal financing costs by the Peruvian Banking Association [49] and is consistent with other estimates [50,51]. We further assumed that the financing needed each month by each boat was equal to the total cost of just one fishing trip.

Annual maintenance costs obtained from the questionnaire survey could not be decomposed into base value, supplier's margin, and taxes because those payments are made to informal contractors, and there is no independent information regarding their margins and tax expenditures. To compute monthly total maintenance costs, we assumed that every boat worked for ten months in a year and received maintenance the remaining two, and because of that, each vessel had a monthly maintenance cost equal to the tenth part of the annual value. The total monthly costs of maintenance were computed by multiplying the monthly cost by the number of boats operating per month. The calculation of financing costs connected to maintenance used the same annual rate as fishing operations, and it was assumed that the two months of maintenance were paid in ten instalments, including principal and interest. As per fishing operation costs, the total cost of financing was the average monthly cost per boat multiplied by the number of boats operating.

Questionnaire survey data also provided information about asset depreciation. Total annual depreciation per boat was calculated as the sum of five ratios, namely the ratio of the original value of engine, hull, navigation equipment, propeller system, and insulation to service life in years of each of these assets. Monthly depreciation rates were obtained by dividing the annual depreciation by 12.

The added value from the fishery was computed on an annual basis as the addition of crew income, taxes, financing costs, depreciation, and the net operative profit, following directives from the European Commission/Directory General for International Partnerships [52]. Finally, the contribution of the JFS fishery to the national economy was calculated by dividing the annualized added value by the total nominal gross domestic product as reported by the Banco Central de Reserva del Perú (BCRP) and the fishing sector gross domestic product as reported by the Instituto Nacional de Estadística e Informática del Perú (INEI).

### 2.3. Supply and price in JFS fisheries in Peru and Chile

Increasing the supply of a commodity without equivalent increases in demand tends to decrease its price. As reported by fishers, in regime 3, there are times when the landings are so high, and off-vessel prices are so low that revenues do not compensate the costs. When that occurs, boats

**Table 1**
The consolidated cost structure of fishing operations by the operational-economic regime in the Peruvian JFS fishery, excluding crew share, pre-payments of income tax, and financing costs.

| Cost item | Base unit | Cost (soles) | | | | Units | | |
|---|---|---|---|---|---|---|---|---|
| | | Total | Base value | Supplier's margin | Taxes | Regime 1 | Regime 2 | Regime 3 |
| Fuel | Galon | 12.1 | 7.0 | 1.8 | 3.3 | 463.2 | 355.7 | 178.7 |
| Ice | Tonne | 161.8 | 112.0 | 28.0 | 21.8 | 12.2 | 11.8 | 10.9 |
| Lubricant | Fishing trip | 184.2 | 127.5 | 31.9 | 24.9 | 1.0 | 1.0 | 1.0 |
| Food and water | Fishing trip | 1123.9 | 777.8 | 194.4 | 151.7 | 1.0 | 1.0 | 1.0 |
| Fishing gear | Fishing trip | 458.3 | 317.2 | 79.3 | 61.9 | 1.0 | 1.0 | 1.0 |
| Pier fees | Tonne | 20.0 | 13.8 | 3.5 | 2.7 | 3.7 | 7.8 | 15.6 |
| Certificate of origin | Tonne | 3.8 | | | 3.8 | 3.7 | 7.8 | 15.6 |

stop fishing and stay at ports waiting for a better price. This suggests a negative impact of excess supply on prices. We fitted nonlinear statistical models to supply and price data, both for prices paid to fishers and exporters, with Peruvian and Chilean data. The models were of the simple power form, where $v$ is the observed price, $S$ is the observed supply, and $a$ and $b$ are constants to be estimated. We fitted this nonlinear model to data $v$ and $S$ by maximum likelihood, assuming a lognormal distribution for the data using the *spg* numerical optimization method with code written in R [53].

## 3. Results

### 3.1. Descriptive economic characterization

Answers to the twenty-eight questionnaires from ship owners operating in the fishery allowed building a database of 84 observations of price per kg paid to fishers, landings, fuel consumption, and the number of fishing trips per month, which was used to characterize the three operational regimes identified by fishers. The three regimes differ in price, landings, fishing effort, and operating costs (Fig. 2). In regime 1, prices are high ($\bar{x} \pm sd = 3.99 \pm 1.03$ soles per kilogram), landings are low ($3.7 \pm 1.7$ tones), and effort ($13.5 \pm 3.3$ days) and operating costs are high ($9420 \pm 3998$ soles per fishing trip). The opposite happens in regime 3, which in the light of the information provided, showed lower off-vessel prices ($1.20 \pm 0.60$), higher landings ($15.6 \pm 5.1$), and lower effort ($4.5 \pm 1.9$) and costs ($6059 \pm 2087$). In extreme cases, when there are very high landings under this latter regime, a part of the fleet momentarily withdraws from fishing because price does not compensate for costs. According to reports in questionnaires, this happens when the off-vessel price, on average, is below $0.74 \pm 0.31$ soles per kilogram. Regime 2 falls in between the two extremes.

Based on the interviews, the average annual investment in maintenance per vessel was estimated at around $22600 \pm 12100$ soles (USD ~ \$$6350 \pm 3400$) plus 16600 soles (~\$4650) of financing cost paid to informal moneylenders, being this – under the assumptions made - around 42% of the money spent for maintenance. The breakdown of the amount effectively used for this purpose was divided into the maintenance of the hull (22%), vessel painting (17%), propeller (17%), engine (14%), grounded to the dry dock and refloated (9%), and vessel' hold and other minor costs (21%). Besides, in the respondents' words, the mean value of a JFS vessel was ~227500 soles (~\$65000), and its annual depreciation was near to 16000 soles (~\$4500). The main assets

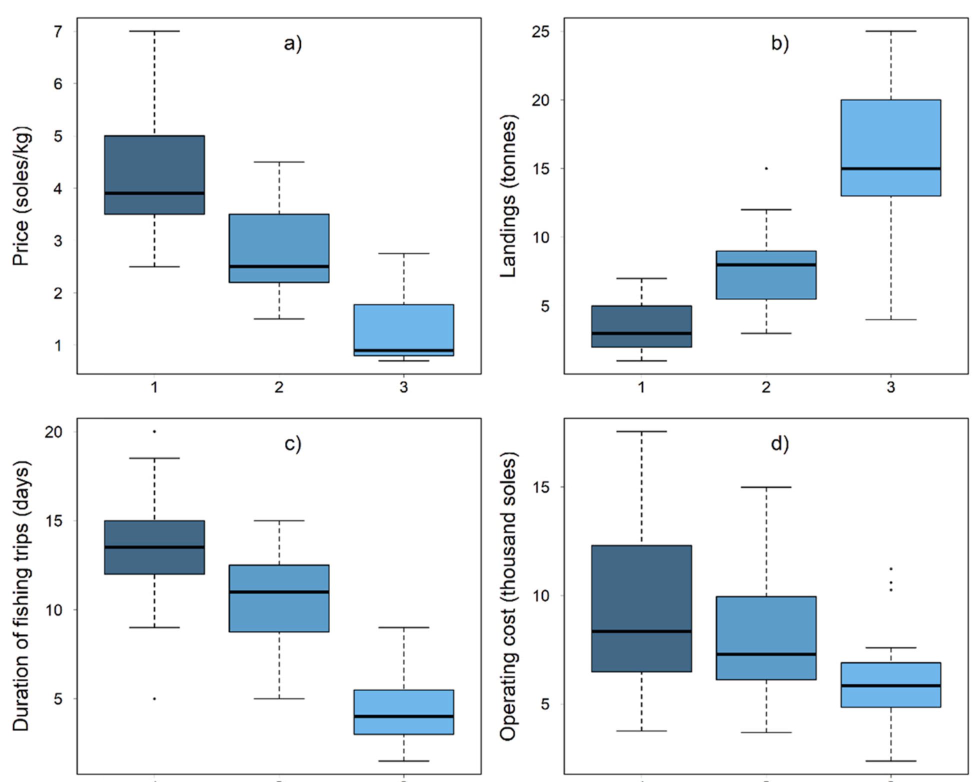


**Fig. 2.** Questionnaire data for the characterization of the three fishing operating regimes of the JFS fleets in Peru in terms of a) landing prices (in soles/kg), b) landing volume per vessel (in tons), c) duration of the fishing trips (in days), and d) operating cost per trip (in thousands of soles).

worth can breakdown in the hull (~93000 ± 35500 soles), the engine (~62200 ± 31700 soles), the navigation equipment (~12600 ± 6000 soles), the propeller system (~32000 ± 17800 soles), and the insulation systems (~27700 ± 19100 soles). The average lifespan of each asset varied between them being 19 years in the case of the hull, 15 for the engine, and 6, 13, and 13 for the navigation, propeller, and insulation systems, respectively.

The monthly evolution of prices, landings, revenues, and operating costs before crew payments, as well as the operating regime, from January 2016 to December 2020 are shown in Fig. 3. During the first year and a half of this time series, the fishery was on the high landings, low price, high resource availability regime (3); then switching to the opposite, low landings, high price, and low resource availability regime (1) during the second half of 2017 and 2018. In the last two years, regime 1 has disappeared, and the fishery has been moving from regime 2 to 3 and vice-versa. Landings and prices remained fairly constant up to mid-2017, and then they varied in the opposite direction once landings fell during the second half of 2017. The onset of fluctuations in supply triggered a period of negative covariation between supply and price, extending to the present time. Fig. 3a shows only one time that both landings and prices dropped down together. That happened in the first months of the COVID-19 outbreak, possibly due to decreased international demand [33]. Despite this, the fishing activity rapidly recovered and surprisingly reached the historical highest landings peak in September 2020, allowing a quick recovery of economic activity and jobs for thousands of artisanal fishers.

Except for a few periods of very low landings (August-September 2017, November 2018, and April-May 2020), revenues substantially exceed operating costs (before salaries, Fig. 3b), thus demonstrating the economic viability of the fishery. As shown in Table 1, most of the operating costs in all three regimes came from fuel (regime 1: 59%; regime 2: 53%, regime 3: 36%), followed by ice (regime 1: 21%; regime 2: 23%, regime 3: 29%).

In the total five-years analysed, crew payments represented 45.6% of the total cost, operating cost covered 44.1%, maintenance represented 7.7%, and depreciation was 2.6%. The operating costs and the crew share were commonly contributed in equal terms except in 2016 (Fig. 4). That year the crew share was substantially more important than operating costs, consistent with 2016 being the only year where all months belonged in regime 3 (Fig. 3).

Furthermore, despite the high impact in fishing activity during the beginning of the COVID-19 outbreak, the annual costs were only 14% below the average of the previous years 2016–2019; therefore, the fishery was able to maintain crew payments and the payment chain in levels near to a pre-pandemic scenario. Likewise, revenue was estimated in ~640 million soles (~$180 million) in 2020, an amount just slightly below the annual average from 2016 to 2019.

Total added value estimated between 2016 and 2020 exceeded 2670 million soles (~780 million USD), of which 83.8% was considered a direct added value. Labour accounted for 50.8%, and net operative profit amounted to 22.3%. The remaining value went to indirect taxes (9.0%), providers' net operating profit (7.2%), financing costs (5.6%), depreciation (2.9%), and direct taxes (2.2%).

The direct added value of the JFS fishery fluctuated around 9–10% of Peruvian fisheries sector gross domestic product (GDP) between 2016 and 2018 before increasing to substantial levels greater to 15% in 2019 (Fig. 5-left). However, it reverted to its original levels during the COVID-19 impacted 2020, and a similar trend occurred concerning the total added value and its contribution to national GDP (Fig. 5).

### *3.2. Supply and price*

Peruvian JFS fishers experience a much more substantial drop in the off-vessel price than Chilean fishers as landings supply increase (Fig. 6a, b). At the highest supply, Peruvian fishers see the price fall to 40% of the price at the lowest supply with a clear power decreasing pattern (Fig. 6a). In the case of Chilean fishers, the power pattern is not well supported by the data because the predicted line is nearly flat for 95% of the variation in supply (Fig. 6b, blue line); thus, an alternative linear model (Fig. 6b, red line) predicts just an 80% drop in price from the minimum to the maximum value of supply. Conversely, when examining export prices in relation to supply (Fig. 6c, d), both countries' sectors demonstrate constant prices for all supply values. In other words, the model for export values is just a constant. Parameter estimates are shown in Table 2. The estimate for *b*, the slope of the power decay, is comparable between models. The slope parameter estimate of the model for Peruvian data is six times higher than the slope estimate of the model for Chilean data. This means that Peruvian fishers experience a much more drastic loss of value with increasing supply.

In reviewing publicly available information on the price dynamics in Chile and after consultations with two key informants, we identified that off-vessels price drops were also an issue for Chilean fishers before 2016 [54–60]. In 2015, the Chilean Jumbo Flying Squid Management Committee began operations. Between September 2015 and May 2016, Chilean squid stakeholders participated in eight committee meetings. The issue of price drops due to periodic market swamps dominated the discussions during the initial phases of the Committee's operation. In the case of Chile, markets swamps resulted from the oversupply brought along by the Olympic career fishing modality under which the industrial sector was catching their quota allocation (20% of the total annual quota). These periodic swamps were reported by the artisanal sector as causing large price drop-downs at landing points [54–56]. In attention to the problem, Chilean authorities proposed splitting the industrial portion of the quota by month as a potential solution [55]. After several sessions of discussion and refinements of the proposal, the artisanal and industrial representatives agreed on distributing the industrial quota in eight months within a year to avoid market swamps [56–60]. This agreement occurred at the beginning of the time series used in this analysis, so creating an analysis of its effects was not possible. However, the analysis of the time series reveals that in contrast to Peru, where swamping the market with product is still a recurrent problem, in Chile, the co-management body enabled the achievement of an arrangement in favor of the economic interest of the catch (both industrial and artisanal) sector.

## 4. Discussion

### *4.1. Economic importance and contribution of the JFS fishery*

The JFS artisanal fishery in Peru is one of the most important fisheries in terms of its contribution to the Peruvian economy, together with the industrial anchoveta fishery, which, although it is low value per unit weight, yields very large volumes. During the five years analysed in this study, JFS fleet activity contributed an annual average of 10.7% of the fisheries sector GDP, compared with an estimated 9.5% of the industrial anchoveta fleet for fishmeal and fish oil in 2009–2012 [61]. Moreover, the stock supports the largest squid fishery in the world in terms of volume since 2004, more than doubling the aggregate contribution of the two next largest squid fisheries, those for *Todarodes pacificus* in the northwest Pacific and *Illex argentinus* in the southwest Atlantic [1,62].

Despite poor government records of the contributions of this fishery to the national economy, this study shows that those contributions are substantial. According to our results, employment created by the fishery amounted to 1350 million soles (~380 million USD) aggregated over the five years of this study. IMARPE has estimated that this fishery directly employs more than twenty thousand fishers [63]. It means that the JFS fishery employs 3.6 times more fishers than the eight largest industrial fishing companies targeting anchoveta for fishmeal and fish oil [31]. These possess more than 60% of anchoveta quota [64] in a fishery that has caught an average of more than 4.1 million of anchoveta tons per year between 2010 and 2019 [1]. Nevertheless, in 2012, only 18% of JFS fishers declared health insurance, less than 12% life insurance, and only

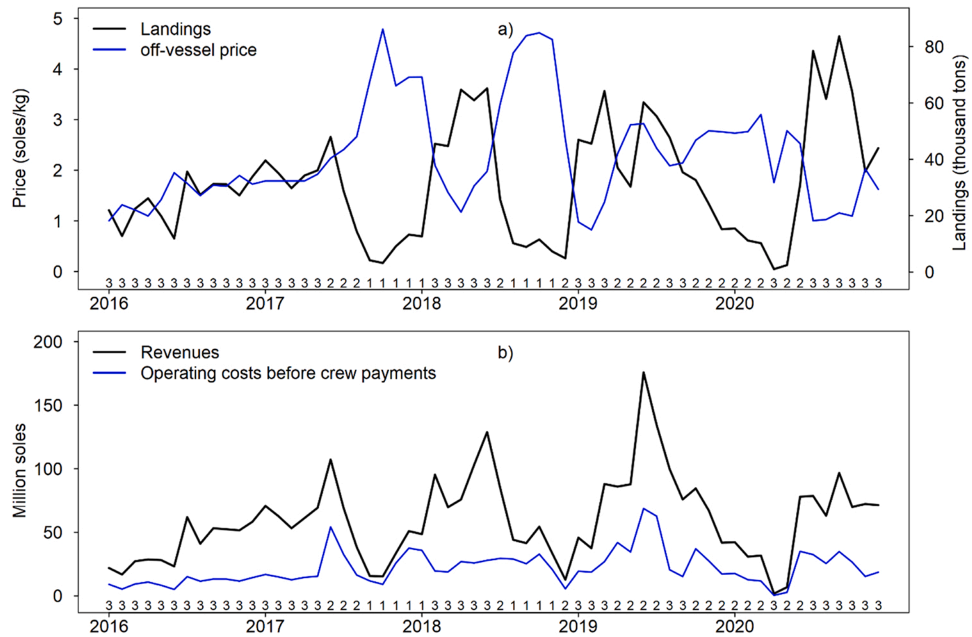


**Fig. 3.** Monthly evolution of a) production and ex-vessel prices, and b) total revenue and operating costs before crew payments by month and fishing regime (over the x-axis) of the JFS fishery in Peru.

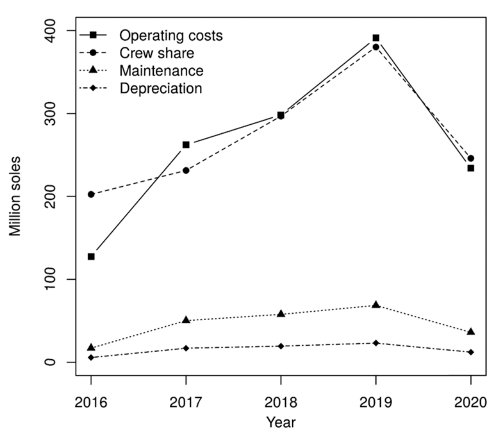


**Fig. 4.** Shares of expenditures by vessel owners of the jumbo flying squid fishery in Peru.

1% pension plans [12] and, during some years, the average payment by crew members have been below than the Peruvian minimum wage [23]. Due to the lack of specific attention to the fishery, it is possible that levels of job-insecurity have remained or even worsened to the present time. In the last decades, Peruvian authorities promoted regulations to the transition to the formal employment within the industrial sector [65, 66]. Despite the reported challenges that still remain to ensure decent work in the industrial fishing sector of Peru [31], lessons can be drawn from the process to advance the transition of the artisanal and small-scale fisheries sector to the formal economy.

Authors have pointed that one of the consequences of informality is that government authorities lack a clear notion of the contribution of the JFS fishery to the national economy [67] and job creation [31]. This provides an explanation as well for the lack of state support proportionate to the magnitude of the fishery, as a large part of the fishing activity is not visible to regulators. A similar case has been reported for the Peruvian scallops' fishery, where the governance structures are not effectively working because the traditional local users are informal and, consequently, invisible in the official map of actors [14].

Another case in point in this line of arguments was the Peruvian government's economic relief measures to help companies process the shocks of the COVID-19 pandemic. Those measures did not help the JFS fishery because credit lines given to artisanal fisheries did not consider the informality status and the high diversity within the small-scale fisheries sector [7]. As a result, the loans provided were not commensurate to the operational expenses of a single fishing trip of the JFS fleet. Furthermore, their informal status has driven disparities to tackle the

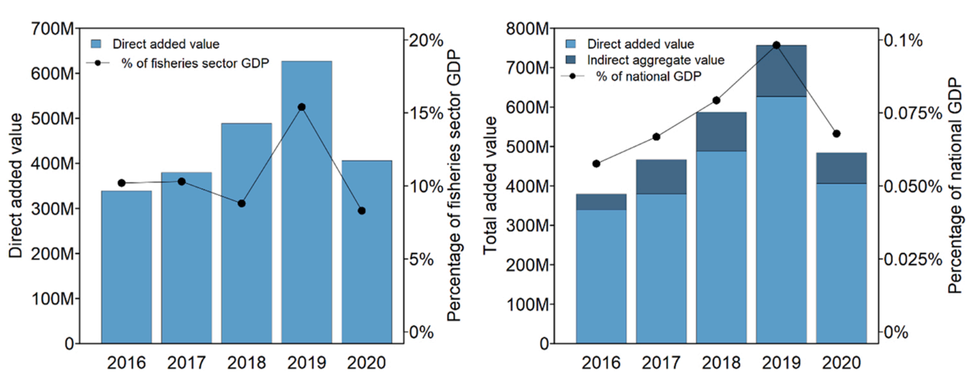


**Fig. 5.** Direct (left) and direct and indirect (right) added value and jumbo flying squid fishery economic contribution to the Peruvian economy.

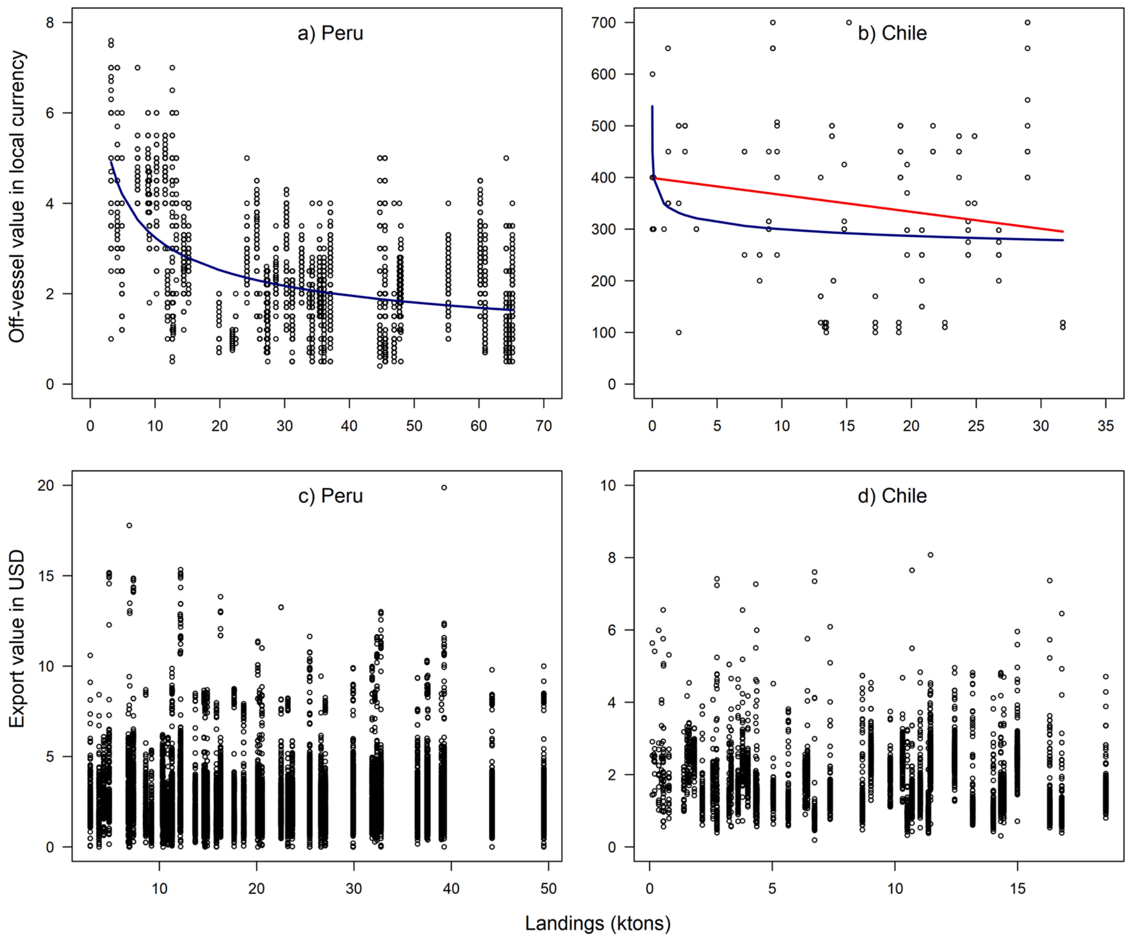


**Fig. 6.** Relation between supply (landings) and price of JFS fishers and exporters in Peru and Chile. In a) the blue line is the fitted power model; in b) the blue line is the fitted power model, and the red line is a fitted linear model. (For interpretation of the references to colour in this figure, the reader is referred to the web version of this article.)

**Table 2**
Parameter estimates of models fitted to supply and value of the JFS fishery in Peru and Chile. Export values are constant, so their mean and standard deviation are reported.

| Item | | Parameter | Estimate (standard error) |
|---|---|---|---|
| | | $a$ | 7.507 (0.211) |
| Peru | Off-vessel value | $b$ | 0.365 (0.008) |
| | | $\sigma^2$ | 0.199 (0.004) |
| | | $a$ | 346.9 (28.6) |
| Chile | Off-vessel (nonlinear) | $b$ | 0.064 (0.030) |
| | | $\sigma^2$ | 0.318 (0.038) |
| Chile | Off-vessel value (linear) | $\beta_0$ | 399.0 (29.3) |
| | | $\beta_1$ | -3.274 (1.614) |
| Peru | Export value | mean | 2.275 (1.916) |
| Chile | Export value | mean | 1.690 (0.779) |

COVID-19 crisis, as also reported in the artisanal hake fishery in northern Peru [17]. Thus, while JFS fishers only accessed high-cost financing in the informal market, the government provided cheap credit through the banking system to support formal companies [19]. Despite this, during 2020, the annual revenue and the payments chains were maintained at levels not too far from an average year, showing the high resilience of the JFS activity.

Some authors have argued for the economic benefits of the entry of industrial operators in this fishery [68], pointing to the potential increase in state income that would result from the payment of fishing rights [12]. From an economic perspective, our results suggest that the entry of industrial operators would have negative consequences. Specifically, the entrance of industrial vessels –or more new unregulated artisanal vessels— would likely aggravate the socio-economic effects of swamping the markets (broadly discussed in Section 4.2), negatively affecting vulnerable communities all along the Peruvian coast as their main economic activity may rapidly become unprofitable. Furthermore, it would result on the displacement of the historical artisanal operators whose tenure rights have been denied due to poor government attention. Last but not least, our analysis shows that artisanal fishers would not have suffered an imbalance in their accounting by paying the cost of fishing rights taxes. For example, if hypothetically, vessel owners had to pay fishing rights during 2016–2020 at the rate per ton paid by the industrial fleets, these costs would not have had any significant impact on the operating costs of the fleet (~4.5 million soles diluted on all vessels along all years).

From a legal perspective, establishing fishing rights taxes for artisanal fleets requires a reform in the Peruvian fishing law, as only industrial vessels are currently obliged to pay those. Yet, the benefits of this policy change in terms of financing specific research and management would be worth the effort. To move forward in this direction will require extensive engagement and dialogue with stakeholders to build consensus about benefits over costs. Advancing in this direction in this specific artisanal fishery also may generate a balance between rights and duties for the artisanal fleet, as suggested by the FAO Small-Scale Fisheries Guidelines [69].

### 4.2. Supply and price relations in Chile and Peru

One key aspect of the economic functioning of the fishery identified through this research was the sharp fall in prices paid to fishers as landings (and therefore supply) increased in Peru. The prices paid to Peruvian squid fishers for their landings decreased by 60%, while Peruvian and Chilean exporters maintained prices at all supply levels. In contrast to Peruvian fishers, Chilean catches experience a mild, 20% drop in prices as landings increase. This may be attributed to a number of causes, including among others the lower yield landed by the Chilean fleet, the growing demand for the product in the international markets, the fact that processors-exporters can store the product for a longer time, differences in infrastructure and logistics by processing plants from both countries, trade agreements entered by the countries during the reporting period affecting the demand (e.g. Peru), the final markets and use of the product (e.g. direct human consumption/fishmeal).[6]

Contributing to all these co-factors, we contend that differences in price elasticity are also the result of the lower bargaining power of the Peruvian catch sector derived from their institutional marginalization and its consequences, such as the resulting debt traps generated by the widespread reliance on informal moneylenders, or the weak organizational capacity required to enable collective action to attain common interests. Our statistical modelling —in which fishers and exporters in Chile display institutional strength and low landings, while fishers and exporters in Peru work with larger landings but differ in institutional strength, isolates institutional strength as the single distinguishing factor of Peruvian fishers and the likely cause of their relatively low performance with high landings.

To confirm the cause-effect linkages between institutional marginalization and price elasticity, we confirmed that the issue of price drops due to market swamps was a problem suffered by Chilean fishers before the launching of the government led Management Committee. During the initial phases of the Committee's operation in 2015, price related discussions were pushed by the artisanal sector and became one of the main focus of the conversations held at the Committee [54–60]. This issue was resolved through an agreement by the representatives of the industrial and artisanal sectors participating in the committee that prevented market swamps resulting from the race to fish by the industrial sector. From then on, the industrial sector agreed to fish their allocated quota in 8 months to avoid swamping the markets. This agreement was made possible by institutional recognition of the catch sector and the launching and operation of the Management Committee (a formal co-management mechanism) where fisherfolk representatives could voice their concerns and effectively participate in fisheries management decision making. This case points to the economic relevance of institutional recognition and suggests that institutional marginalization of the Peruvian artisanal catch sector may be preventing higher economic efficiency that would bring along environmental benefits, prevent social tensions and even the continuous rise of illegal markets for the product.

### 4.3. Informality as a governance problem and co-management as a framework to solve it

The paramount relevance of informality in the Peruvian economy has clearly identified drivers. Following the Peruvian National Center for Strategic planning (CEPLAN), informality results from overregulation, corruption and lack of transparency, low government transfers to families, low investment in research and development, and people's low average years of formal education [70]. The informal nature of the JFS fishing can be understood as an expression of governance weaknesses that brings along a number of challenges to multiple actors involved in the supply chain. Solutions therefore, may be focused on addressing governance gaps.

Social science literature has identified institutional weaknesses (see [8]) as causes of fishers' vulnerability. In view of our results, consideration of these negative consequences from a bioeconomic perspective requires greater integration in fisheries governance and decision making. For example, issues such as debt bondage derived from reliance on informal moneylenders, which have been identified as leading to negative environmental outcomes (e.g., [71]), are still poorly integrated into fisheries' decision-making.

Regional experience shows the benefits of implementing co-management solutions in small-scale fisheries (e.g. [72,73]). Gelcich et al. [74] show that one of the critical positive outcomes of implementing co-management schemes in Chilean artisanal fisheries was that fishers acquired the ability to network knowledge from the local level to influence the decision-making processes at the national level. Thus, under effective co-management, fishers may be able to tackle a number of issues affecting social-ecological systems [75]. In fact, it has been shown that even in the absence of scientific research and top-down control of harvest rates [76] —as it is common in most small-scale fisheries in the region, the very existence of co-management mechanisms within the governance system yields healthier fish stocks by enabling fishers alignments with biologically sustainable fishing rates and long-term objectives. Further to environmental sustainability gains, in this paper we suggest that institutional recognition and active co-management may help addressing economic inefficiencies. To do so, in contrast to Chile, Peru still needs to further generate the conditions and develop the policy frameworks to enable participatory co-management institutions and mechanisms in the JFS fishery. Effective co-management institutions are the result of clearly identified factors such as leadership [77] and pre-conditions such as secure tenure rights [78] granted by state authorities [79] and its effectiveness may be put at risk by bad institutional practices and corruption [80], some of the very factors pointed in the first place by CEPLAN as the cause of informality in Peru [70].

## CRediT authorship contribution statement

**Renato Gozzer-Wuest:** Conceptualization, Methodology, Primary data collection, Data Curation, Formal analysis, Writing – original draft, Writing – review & editing, Visualization. **Enrique Alonso-Población:** Conceptualization, Methodology, Writing – original draft, Writing – review & editing, Supervision, Project administration. **Stefany Rojas-Perea:** Data gathering, Primary data collection, Writing – review & editing. **Rubén H. Roa-Ureta:** Conceptualization, Methodology, Data Curation, Formal analysis, Writing - original draft, Writing – review & editing, Visualization.

## Declaration of interest

None.

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## Appendix A. Supporting information

Supplementary data associated with this article can be found in the online version at doi:10.1016/j.marpol.2021.104886.

[6] A Chilean government report pointed out that up to 30% of JFS landings go to squid meal in Chile [81], so this issue may not be a relevant factor.

## References


[1] FAO, Fisheries and aquaculture software. FishStatJ - Software for Fishery and Aquaculture Statistical Time Series. Bibliographic citation [online]. Rome. Updated 14 September 2020. [Cited 6 March 2021], (2021).
[2] PRODUCE, Anuario Estadístico Pesquero y Acuícola 2019, 2020. 〈https://ogeiee.produce.gob.pe/index.php/en/shortcode/oee-documentos-publicaciones/publicaciones-anuales/item/949-anuario-estadistico-pesquero-y-acuicola-2019〉.
[3] PROMPERÚ, Desenvolvimiento del comercio exterior pesquero y acuícola en el Perú. Informe Anual 2019, 2020.
[4] R. Guevara-Carrasco, A. Bertrand, (Eds). Atlas de la pesca artesanal del mar del Perú, 2017. 〈http://biblioimarpe.imarpe.gob.pe/handle/123456789/3167〉.
[5] R. Guevara, L. Mariátegui, C. Yamashiro, Aspectos de la ordenación pesquera del calamar gigante o pota (Dosidicus gigas) y la variabilidad climática en el Perú, Bol. Inst. Del. Mar. Del. Perú 33 (2018) 285–301. 〈http://biblioimarpe.imarpe.gob.pe/handle/123456789/3240〉.
[6] C.M. Salazar-Céspedes, L. Giampietri-Rojas, J. Alarcón-Vélez, D. Thorne-Martinez, Guidelines for the adaptation and development of a Peruvian fleet specializing in the capture of jumbo flying squid Dosidicus gigas, Bol. Inst. Mar. Perú. 33 (2018) 266–284. 〈http://biblioimarpe.imarpe.gob.pe/handle/123456789/3241〉.
[7] S. Jentoft, R. Chuenpagdee, Fisheries and coastal governance as a wicked problem, Mar. Policy 33 (2009) 553–560, https://doi.org/10.1016/j.marpol.2008.12.002.
[8] S. Jentoft, A. Eide (Eds.), Poverty mosaics: realities and prospects in small-scale fisheries, Springer Science & Business Media., 2011.
[9] M. de Oliveira Leis, M.J. Barragán-Paladines, A. Saldaña, D. Bishop, J.H. Jin, V. Kereži, M. Agapito, R. Chuenpagdee, Overview of Small-Scale Fisheries in Latin America and the Caribbean: Challenges and Prospects, in: 2019: pp. 15–47. https://doi.org/10.1007/978–3-319–76078-0_2.
[10] G. Castillo, J. Fernandez, A. Medina, R. Guevara-Carrasco, Tercera Encuesta Estructural De La Pesquería Artesanal En El Litoral Peruano. Resultados Generales, Inf. Inst. Mar. Perú 45 (2018) 95.
[11] R. Gozzer-Wuest, E. Alonso-Población, G. Tingley, Identifying priority areas for improvement in Peruvian Fisheries, Mar. Policy (2021), https://doi.org/10.1016/j.marpol.2021.104545.
[12] C.E. Paredes, S. De La Puente, Situación actual de la pesquería de la pota (Dosidicus gigas) en el Perú y recomendaciones para su mejora, 2014.
[13] R. Oyanedel, Illegal fishing and non-compliance. Marine and Fisheries Policies in Latin America, Routledge,, 2019, pp. 45–54.
[14] D. Laínez del Pozo, P.J. Jones, Governance analysis of two historical MPAs in northern Peru: Isla Lobos de Tierra and Isla Lobos de Afuera, Mar. Policy 127 (2021), 104096, https://doi.org/10.1016/j.marpol.2020.104096.
[15] L.C. Kluger, R. Filgueira, C.J. Byron, Using media analysis to scope priorities in social carrying capacity assessments: a global perspective, Mar. Policy 99 (2019) 252–261, https://doi.org/10.1016/j.marpol.2018.10.042.
[16] A. Sota, The politics of artisanal fisherfolk of anchoveta: Challenging the success of sustainable fishing. Agrarian, Food and Environmental Studies (AFES). The Hague, The Netherlands, 2018. 〈https://thesis.eur.nl/pub/46465〉.
[17] J. Grillo-Núñez, T. Mendo, R. Gozzer-Wuest, J. Mendo, Impacts of COVID-19 on the value chain of the hake small scale fishery in northern Peru, Mar. Policy 134 (2021), 104808, https://doi.org/10.1016/j.marpol.2021.104808.
[18] International Monetary Fund, IMF Country Report No. 21/63 Peru Staff Report for the 2021 Article IV Consultation, 2021. <https://www.imf.org/en/Publications/CR/Issues/2021/03/24/Peru-2021-Article-IV-Consultation-Press-Release-Staff-Report-and-Statement-by-the-Executive-50305>
[19] L. Varona, J.R. Gonzales, Dynamics of the impact of COVID-19 on the economic activity of Peru, PLoS One 16 (2021), e0244920, https://doi.org/10.1371/journal.pone.0244920.
[20] INEI, Producción y empleo informal en el Perú. Cuenta Satélite de la Economía Informal 2007–2018, 2019. 〈https://www.inei.gob.pe/media/MenuRecursivo/publicaciones_digitales/Est/Lib1701/libro.pdf〉.
[21] FAO, Increasing the contribution of small-scale fisheries to poverty alleviation and food security. FAO Technical Guidelines for Responsible Fisheries. No. 10. Rome, FAO. 79 pp, 2005.
[22] L.G. Anderson, J.C. Seijo, Bioeconomics of fisheries management, John Wiley & Sons,, 2010.
[23] S. De la Puente, R. López de la Lama, S. Benavente, J.C. Sueiro, D. Pauly, Growing into poverty: reconstructing peruvian small-scale fishing effort between 1950 and 2018, Front. Mar. Sci. 7 (2020) 1–14, https://doi.org/10.3389/fmars.2020.00681.
[24] A. Nakandakari, M. Caillaux, J. Zavala, S. Gelcich, F. Ghersi, The importance of understanding self-governance efforts in coastal fisheries in Peru: insights from La Islilla and Ilo, Bull. Mar. Sci. 93 (2017) 199–216, https://doi.org/10.5343/bms.2015.1087.
[25] E. Zamora, Integrate use of drones and qr codes as complementary components for monitoring, control and surveillance systems for artisanal fishing vessels in Peru, (2018).
[26] A. Cuba, Extractive industries in coastal and marine zones. Marine and Fisheries Policies in Latin America, Routledge,, 2019, pp. 55–65.
[27] M. Carrere, Perú: formalización pesquera está por vencer y miles de pescadores podrían quedar en la ilegalidad, El Comer. (2021).
[28] S. Jentoft, M. Bavinck, E. Alonso-Población, A. Child, A. Diegues, D. Kalikoski, J. Kurien, P. McConney, P. Onyango, S. Siar, V.S. Rivera, Working together in small-scale fisheries: harnessing collective action for poverty eradication, Marit. Stud. 17 (2018) 1–12, https://doi.org/10.1007/s40152-018-0094-8.
[29] E. Cabral, Embarcaciones ilegales: La ruta de los astilleros | Ojo Público, Ojo Público. (2017). 〈https://ojo-publico.com/488/embarcaciones-ilegales-la-ruta-de-los-astilleros〉 (accessed March 21, 2021).
[30] Sociedad Peruana de Derecho Ambiental - SPDA, Guía legal para la defensa de los ecosistemas y especies del mar peruano. Lima: SPDA, 2019.
[31] L. Murillo, L. Maffei, J.C. Sueiro, Peruvian fisheries: a transition towards labour and environmental sustainability, Int. J. Labour Res (2014) 187–216.
[32] M. Garteizgogeascoa, L.C. Kluger, I.E. Gonzales, G. Damonte, M. Flitner, Contextualizing scenarios to explore social-ecological futures: a three step participatory case study for the Humboldt current upwelling system, Front. Mar. Sci. 7 (2020), https://doi.org/10.3389/fmars.2020.557181.
[33] SFP, Impacts of COVID-19 in Target 75 Fisheries. Summary of preliminary findings. Honolulu: Sustainable Fisheries Partnership Foundation., 2020.
[34] FAO, Impact of COVID-19 on informal workers. Rome., 2020.
[35] La Hora, Protesta de poteros termina en enfrentamiento y bombas, (2020). 〈https://lahora.pe/sullana-paita-tambogrande-poteros-pnp/〉.
[36] RPP, Pescadores de pota acatan paro por 15 días para regular precio, (2018). 〈https://rpp.pe/peru/piura/pescadores-de-pota-acatan-paro-por-15-dias-para-regular-precio-noticia-1108126?ref=rpp〉 (accessed April 28, 2021).
[37] J. Grillo, R. Gozzer, J.C. Sueiro, J.C. Riveros, Producción ilegal de harina de pescado en Perú a partir de anchoveta extraída por la flota artesanal y de menor escala. Reporte preparado para OCEANA., 2019. https://doi.org/10.13140/RG.2.2.18562.53448/1.
[38] Perú21, Sullana: intervienen planta ilegal de procesamiento de pescado y pota, Perú21. (2021). 〈https://peru21.pe/peru/ministerio-publico-sullana-intervienen-planta-ilegal-de-procesamiento-de-pescado-y-pota-noticia/〉 (accessed March 22, 2021).
[39] Walac, Intervienen 3 procesadoras ilegales y decomisan 40 toneladas de pota, Walac. (2019). 〈https://walac.pe/intervienen-3-procesadoras-ilegales-y-decomisan-40-toneladas-de-pota/〉 (accessed March 22, 2021).
[40] USITC, Seafood Obtained via Illegal, Unreported, and Unregulated Fishing: U.S. Imports and Economic Impact on U.S. Commercial Fisheries. United States International Trade Commission., 2021. 〈https://www.usitc.gov/publications/332/pub5168.pdf〉.
[41] A.M. Song, J. Scholtens, K. Barclay, S.R. Bush, M. Fabinyi, D.S. Adhuri, M. Haughton, Collateral damage? small-scale fisheries in the global fight against IUU fishing, Fish Fish. 21 (2020) 831–843, https://doi.org/10.1111/faf.12462.
[42] PRODUCE, Desenvolvimiento Productivo de la Actividad Pesquera Diciembre 2017. In Oficina de Estudios Económicos., 2018.
[43] PRODUCE, Anexos del Boletín del Sector Pesquero Desenvolvimiento Productivo de la Actividad Pesquera Diciembre 2019., 2020.
[44] PRODUCE, Desenvolvimiento Productivo de la Actividad Pesquera. Diciembre 2020. In Oficina de Estudios Económicos., 2020.
[45] IMARPE, INFOMAR: Proyecto Pesca Artesanal - Sistema de información de precios playa, mareas y oleajes, (2020).
[46] BCRP, Series de tiempo de inflación del Banco Central de Reserva del Perú., 2020. (n.d.).
[47] INEI, Metodología del cálculo del índice de precios al consumidor de Lima Metropolitana., 2001.
[48] Ministerio de Energía y Minas, Informe Estadístico Mensual, Estadísticas Mens. (2021).
[49] ASBANC, Estudio: Costo del Crédito Bancario vs. Crédito Informal. Asociación de Bancos del Perú. Departamento de Estudios Económicos., 2013.
[50] M. Guillen Rispa, J. Mogrovejo Gonzalez, M. Zaldivar Chauca, J. Poggi Campodonico, Informe No 008–2020-SAEE/ No 040 -2020-SABM / N°121–2020-SAAJ/ No 015 -2020-SACMIF. Opinión sobre Proyecto de Ley N° 5598/2020-CR, 2020.
[51] Instituto Peruano de Economía, El crédito informal en el Perú, 2012.
[52] P. Fabre, M.-H. Dabat, O. Orlandoni, Methodological brief for agri-based valua chain analysis. Frame and Tools - Key Features., 2021.
[53] R Core Team, R: A language and environment for statistical computing. R Foundation for Statistical Computing, Vienna, Austria. 〈https://www.R-project.org/〉., (2021).
[54] SUBPESCA, Acta de Acuerdos del Comité de Manejo de Jibia (CMJ). Reunión CM-Jibia_01–2015-01, 2015. 〈https://www.subpesca.cl/portal/616/articles-91276_documento.pdf〉.
[55] SUBPESCA, Acta de Acuerdos del Comité de Manejo de Jibia (CMJ). Reunión CM-Jibia_02–2015-02, 2015.
[56] SUBPESCA, Acta de Acuerdos del Comité de Manejo de Jibia (CMJ). Reunión CM-Jibia_03–2015-03, 2015. 〈https://www.subpesca.cl/portal/616/articles-92980_documento.pdf〉.
[57] SUBPESCA, Acta de Acuerdos del Comité de Manejo de Jibia (CMJ). Reunión CM-Jibia_04–2015-04, 2015. 〈https://www.subpesca.cl/portal/616/articles-92981_documento.pdf〉.
[58] SUBPESCA, Acta de Acuerdos del Comité de Manejo de Jibia (CMJ). Reunión CM-Jibia_01–2016-05, 2016. 〈https://www.subpesca.cl/portal/616/articles-92982_documento.pdf〉.
[59] SUBPESCA, Acta de Acuerdos del Comité de Manejo de Jibia (CMJ). Reunión CM-Jibia_02–2016-06, 2016. 〈https://www.subpesca.cl/portal/616/articles-93890_documento.pdf〉.
[60] SUBPESCA, Acta de Acuerdos del Comité de Manejo de Jibia (CMJ). Reunión CM-Jibia_04–2016-08, 2016. 〈https://www.subpesca.cl/portal/616/articles-93892_documento.pdf〉.
[61] V. Christensen, S. de la Puente, J.C. Sueiro, J. Steenbeek, P. Majluf, Valuing seafood: the Peruvian fisheries sector, Mar. Policy 44 (2014) 302–311, https://doi.org/10.1016/j.marpol.2013.09.022.
[62] A.I. Arkhipkin, P.G.K. Rodhouse, G.J. Pierce, W. Sauer, M. Sakai, L. Allcock, J. Arguelles, J.R. Bower, G. Castillo, L. Ceriola, C.-S. Chen, X. Chen, M. Diaz-Santana, N. Downey, A.F. González, J. Granados Amores, C.P. Green, A. Guerra, L.

C. Hendrickson, C. Ibáñez, K. Ito, P. Jereb, Y. Kato, O.N. Katugin, M. Kawano, H. Kidokoro, V.V. Kulik, V.V. Laptikhovsky, M.R. Lipinski, B. Liu, L. Mariátegui, W. Marin, A. Medina, K. Miki, K. Miyahara, N. Moltschaniwskyj, H. Moustahfid, J. Nabhitabhata, N. Nanjo, C.M. Nigmatullin, T. Ohtani, G. Pecl, J.A.A. Perez, U. Piatkowski, P. Saikliang, C.A. Salinas-Zavala, M. Steer, Y. Tian, Y. Ueta, D. Vijai, T. Wakabayashi, T. Yamaguchi, C. Yamashiro, N. Yamashita, L.D. Zeidberg, World Squid Fisheries, Rev. Fish. Sci. Aquac. 23 (2015) 92–252, https://doi.org/10.1080/23308249.2015.1026226.

[63] J. Csirke, J. Argüelles, A. Alegre, P. Ayón, M. Bouchon, G. Castillo, R. Castillo, R. Cisneros, R. Guevara-Carrasco, L. Lau, L. Mariátegui, C. Salazar, R. Tafur, J. Torrejón, C. Yamashiro, Biología, estructura poblacional y pesquería de pota o calamar gigante (Dosidicus gigas) en el Perú, Bol. Inst. Del. Mar. Del. Perú 33 (2018) 302–364. ⟨http://biblioimarpe.imarpe.gob.pe/handle/123456789/3239⟩.

[64] E. Conterno, Cuotas Individuales: Reflexiones desde la Industria de Ingredientes Marinos. Sociedad Nacional de Pesquería. Presentación en el Foro para la Pesca y Acuicultura Sostenibles del 26/03/2018, 2018. ⟨https://www.fpas.pe/wp-content/uploads/Cuotas-individuales-reflexiones-desde-la-industria-de-Ingredientes-Marinos.pdf⟩.

[65] I. Demarini Villarroel, La labor del trabajo social en el sector pesquero peruano: sistematización de la experiencia profesional con pescadores de embarcaciones industriales en el Perú. Tesis para optar el títutlo profesional de Licenciada en Trabajo Social. Universidad Nacional, 2019. ⟨http://cybertesis.unmsm.edu.pe/bitstream/handle/20.500.12672/11447/Demarini_vi.pdf?sequence=3&isAllowed=y⟩.

[66] L. Jiménez Coronado, Régimen laboral del trabajador pesquero, Actual. Empres. 343 (2016) 4–5.

[67] E. McKinley, O. Aller-Rojas, C. Hattam, C. Germond-Duret, I.V. San Martín, C. R. Hopkins, H. Aponte, T. Potts, Charting the course for a blue economy in Peru: a research agenda, Environ. Dev. Sustain. 21 (2019) 2253–2275, https://doi.org/10.1007/s10668-018-0133-z.

[68] D. Flores, S.J. Bucaram-Villacís, E. Paredes, C.E. Paredes, Cómo generar más valor en la pesca artesanal?: Desafíos, brecha de valor potencial y recomendaciones de política, Washington, D.C., 2021. https://doi.org/10.18235/0003001.

[69] FAO, Voluntary Guidelines for Securing Sustainable Small-Scale Fisheries in the Context of Food Security and Poverty Eradication, 2015. ⟨https://www.fao.org/3/i4356en/I4356EN.pdf⟩.

[70] CEPLAN, Economía informal en Perú: Situación actual y perspectivas. Centro Nacional de Planeamiento Estratégico. Lima, Perú., 2016. ⟨www.ceplan.gob.pe⟩.

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

[72] J.C. Castilla, O. Defeo, Latin American benthic shellfisheries: emphasis on co-management and experimental practices, Rev. Fish Biol. Fish. 11 (2001) 1–30, https://doi.org/10.1023/A:1014235924952.

[73] O. Defeo, J.C. Castilla, More than one bag for the world fishery crisis and keys for co-management successes in selected artisanal Latin American shellfisheries, Rev. Fish Biol. Fish. 15 (2005) 265–283, https://doi.org/10.1007/s11160-005-4865-0.

[74] S. Gelcich, T.P. Hughes, P. Olsson, C. Folke, O. Defeo, M. Fernandez, S. Foale, L. H. Gunderson, C. Rodriguez-Sickert, M. Scheffer, R.S. Steneck, J.C. Castilla, Navigating transformations in governance of Chilean marine coastal resources, Proc. Natl. Acad. Sci. 107 (2010) 16794–16799, https://doi.org/10.1073/pnas.1012021107.

[75] O. Defeo, M. Castrejón, R. Pérez-Castañeda, J.C. Castilla, N.L. Gutiérrez, T. E. Essington, C. Folke, Co-management in Latin American small-scale shellfisheries: assessment from long-term case studies, Fish Fish. 17 (2016) 176–192, https://doi.org/10.1111/faf.12101.

[76] R.H. Roa-Ureta, J. Henríquez, C. Molinet, Achieving sustainable exploitation through co-management in three Chilean small-scale fisheries, Fish. Res. 230 (2020), 105674, https://doi.org/10.1016/j.fishres.2020.105674.

[77] N.L. Gutiérrez, R. Hilborn, O. Defeo, Leadership, social capital and incentives promote successful fisheries, Nature 470 (2011) 386–389, https://doi.org/10.1038/nature09689.

[78] F. Berkes, Managing small-scale fisheries: alternative directions and methods. IDRC, 2001.

[79] R.S. Pomeroy, The Government as a Partner in Co-Management, in: Fish. Co Manag. Exp, Springer, Netherlands, Dordrecht, 2003, pp. 247–261, https://doi.org/10.1007/978-94-017-3323-6_15.

[80] F. Nunan, D. Cepić, E. Yongo, M. Salehe, B. Mbilingi, K. Odongkara, P. Onyango, E. Mlahagwa, M. Owili, Compliance, corruption and co-management: how corruption fuels illegalities and undermines the legitimacy of fisheries co-management, Int. J. Commons 12 (2018), https://doi.org/10.18352/ijc.827.

[81] Vilena, Diagnóstico del consumo interno de productos pesqueros en Chile. SCL Economrics, Santiago, Chile, 2012. ⟨https://www.subpesca.cl/portal/618/articles-94615_documento.pdf⟩.