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Research Article

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Factors Affecting the Demand and Price Elasticity for Little Tuna in Kotabaru District, South Kalimantan, Indonesia

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Abstract

The research focused on factors affecting the demand and price elasticity for tittle tuna (Euthynnus affinis) in Kotabaru District, South Kalimantan Province of Indonesia. A total of 34 gillnet ship-owners were selected as the respondents to be further interviewed using questionnaire. Three independent variables i.e. price of little tuna (X_1) at fishermen, price of little tuna at consumers (X_2) and the price of Indian mackerel as substitute goods (X_3) were tested to determine whether they had a significant effect on the demand for little tuna (Y). Data were input into MINITAB software and analyzed with multiple linear regressions. Data were normally distributed and free from multicollinearity and autocorrelation. The results were tested with the F-test and t-test at a confidence level of 95%. The regression equation of the model was expressed as: $LnY = 29.57 + 0.524LnX_1 - 0.719LnX_2 - 2.175LnX_3$. More than 64% of variability of little tuna demand was explained by the independent variables and the rest of 36% was attributed to other variables not included in the model equation. The demand for little tuna was simultaneously significantly affected by the independent variables tested ($P < 0.01$). Further analysis separately showed that X_1 and X_2 had no significant effect on the little tuna demand ($P > 0.05$), while X_3 in the model showed an evidence of a positive relationship ($P < 0.01$). The price elasticity of demand for little tuna was categorized perfectly inelastic. The changes in the prices of little tuna and Indian mackerel are complementary, and the preference is independently selected by the consumers.

Keywords: Little Tuna, Indian Mackerel, Elasticity of Demand, Kotabaru,

Introduction

It is generally accepted that the capture fishery plays important role in producing food for the community, creating job opportunities, increasing the welfare of the community, supporting the development of other sectors through the provision of market and industrial materials for domestic production and generating foreign exchange through fishery exports [1, 2]. Currently the fishery sector contributes about 8% of national gross domestic product. More than 11 million people are working in this sector as fishermen (8.69%), fish farmers (35.06%), fish processors and fish marketers (55.84%), and salt farmers (0.41%). The productivity of fishing business is generally determined by several simultaneous factors, including the condition of biological resources and aquatic ecosystems, fuel subsidy reform, a great degree of involvement from the fishing community in producing and operating fishing gears, as well as service support of national policies and legislations [3-5]. In line with this, Yudistira have proven that the income obtained from the catch have significantly contributed to the economics of fishermen as a whole [6]. Meanwhile, the consumers preferred to buy high quality and fresh fish to ensure the health safety and satisfaction needs of their families are met [7].

Among marine fishes production, the little tuna (*Euthynnus affinis*) and Indian mackerel (*Rastreliger kanagurta*) are considered commercially important pelagic fish particularly in Asian countries including Indonesia [8]. Most of them caught by gill net and purse seine and the use of fish aggregating devices (FADs) effectively increases the fish production [9, 10]. The demand for fish is not only in fresh form, but also in processed form such as canned fish, meatballs, nuggets, and other products. Kotabaru District is one the largest fish producers in South Kalimantan Province. Table 1 shows the annual pelagic fish production that is commercially landed in Kotabaru Fishing Port within the last five years (2016-2020). The catch production and fish prices fluctuate depending on the fishing season. The consumers usually get lower prices during the peak fishing season and they will pay a higher price for fish during low season. Several factors identified to influence the market price of fish such as the quality, size, species type, distance to

the market, market type, weather condition, and the price demand of key informants [7, 11,12]. The other factors related to market structure, storable and non-storable products, domestic price and production-retail price differentials [13]. While the demand for fish is mainly affected by the seasonal price variation, the price of other goods, the income level and preference of consumers [14-16].

Table 1: The criteria used to express the elasticity of demand for little tuna

Regression coefficient	Explanation for price elasticity of demand for Indian mackerel	Remarks
b > 1	Price elastic	• If the regression coefficient (b) is negative, it means that the relationship between little tuna and Indian mackerel is complementary; • If it is positive, it means that Indian mackerel is a substitute for little tuna
0 > b < 1	Inelastic to price	
b = 1	Unitary elastic to price	
b = 0	Perfectly inelastic to price	
b = ~	Perfectly elastic to price	
b = 0	Little tuna fish has no relationship with Indi-an mackerel	
b ≠ 0	Little tuna fish has relationship with Indian mackerel.	

BPS (2020) reports that there are 75,351 households in Kotabaru District, about 15,961 of them are fishermen's households. It means that about 21.18% of the population hanging their economic life up on capture fishery sector. Meanwhile the demand for little tuna or Indian mackerel in the investigated area is likely influenced by the price change of fish and the availability of fish stock. For this reason, we examined factors affecting the demand for little tuna by analyzing the price of little tuna at producer and the prices of little tuna and Indian mackerel at consumer level, as well as the magnitude of demand elasticity for little tuna. The results of this study are expected to provide information on how to maintain the stability of prices and continuity of fishery business in this area of study.

Materials and Methods

Study Site

This research was conducted in Hilir Muara Village, Kotabaru District of South Kalimantan Province, Indonesia, located at 4'15°S and 96'43°E (Figure 1). It was about 5 km from the sub-district capital of Pulau Laut Utara when it takes about 15 min by a car. The majority of the villager's population came from Bugis (68%), followed by Banjar (24%), and the rest are Javanese, Makassar, Mandar, Batak, Balinese, Madurese, Flores and Chinese. This research site was determined purposely where fishing activities started and most of catches (little tuna and Indian mackerel) landed in the investigated area. The buying and selling transactions of catches were directly done by fishermen and wholesaler without going through the fish carrier at sea.

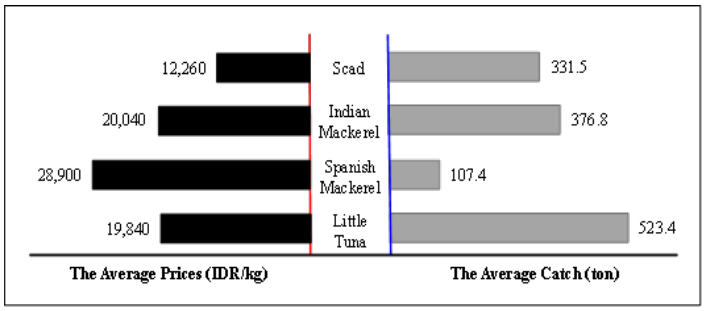

Figure 1: The average prices and catches of commercial pelagic fish landed in Kotabaru Fishing Port within the five last years (2016-2020)

Morphological Characteristic of Little Tuna

Little tuna is an epipelagic, neritic species inhabiting water temperatures from 18 to 29°C. It belongs to the Scombridae family and categorized as fast swimmer fish [17]. This species tends to form multispecies schools by size with small *Thunnus albacares, Katsuwonus pelamis, Auxis sp. and Megalaspis cordyla*, comprising from 100 to over 5000 individuals. As described by Ahmed et al., little tuna has dorsal markings composed of broken oblique stripes [9]. The body is robust, elongate and streamlined. The first dorsal and first anal fins can fold down into grooves and the pectoral and pelvic fins into depressions when the fish is swimming rapidly. It has 29-33 gill rakers on the first arch and 28 or 29 gill teeth, while vomerine teeth are absent. A pair of caudal keels lies on the middle of the caudal peduncle at the base of the caudal fin. There are 10 to 14 anal fin rays; vertebrae 39 have no trace of vertebral protuberances; bony caudal keels lay on vertebrae 33 and 34. It has two distinct dorsal fins, generally separated, the first one supported by spines and the second only by soft rays. The pelvic fins are inserted below the base of the pectoral fins.

Characteristic of Respondents

A total of 34 gillnet ship-owners were selected as the respondents to be further interviewed using questionnaire. Most of fishermen had more than 20 years of experience fishing at sea. The age of respondents was ranged of 30-60 year old with dependent family member of 2-13 persons. The majority of the education level was elementary school. The fishermen usually use the gill nets for catching little tuna, Indian mackerel, scad, sardines and other pelagic fishes. The gill nets are considered as environmentally friendly fishing gears and research on this gear continuous to be developed [1, 18-21]. The catch is usually directly marketed in the form of fresh fish. The proportion of net-profit sharing was 50% for the gillnet ship-owner and 50% for the crews (4-5 persons).

Data Collection

The research activities started from June to December 2020. The primary data collected include data on prices and volume of little tuna production at producers, the fish prices of little tuna and Indian mackerel at the end consumer level. Addition information on the number of fishermen, fishing gears, fishing boats and type of fish caught were also collected from a local authority. A time series of annual fish production was also presented to complement this study. Data were analyzed using descriptive analysis both qualitatively and quantitatively. The results were presented in tabular

form, graphic or percentage.

Data Analysis

The Influence of Prices

The regression equation model was used to analyze the influence of little tuna prices at producers and the end consumers, and the price of Indian mackerel as substitute goods toward the demand of little tuna. Data were input and analyzed using MINITAB software. The regression equation model can be expressed as:

$$\text{Ln } Y = a + b1 \text{ Ln } X_1 + b_2 \text{ Ln } X_2 + b_3 \text{ Ln } X_3 + \mu i$$

Where Y is number of little tuna on demand (kg), X_1 = price of little tuna at fishermen (IDR/kg), X_2 = price of little tuna at consumers (IDR/kg), X_3 = price of Indian mackerel at consumers (IDR/kg), a = constant, b = regression coefficient or elasticity with respect to Xi, μi = error (disturbance term).

Several assumptions need to be made to fit the best linear unbiased estimator, namely: (1) normality: the dependent variable (Y) is normally distributed to the independent variable (X); (2) homoscedasticity: variable Y associated with X values has the same variants; (3) there is no serial correlation (autocorrelation) on variable X; and (4) in multiple regression, there is no perfect linear relationship between the variable X (no perfect multicollinearity).

The Durbin-Watson Statistic (d) is used to test the autocorrelation of the residuals obtained from a linear regression model. The test statistic ranges in between 0 to 4. If $d = 2$ indicates that there is no autocorrelation. If $d < 2$, there is evidence of positive serial correlation. If $d > 2$, successive error terms are negatively correlated. In regressions, this can imply an underestimation of the level of statistical significance. The variance inflation factor (VIF) was applied to detect any multicollinearity in the model. If VIF = 1, there is no multicollinearity, if VIF = 4-5 indicates moderate multicollinearity; and if VIF ≥ 10 point toward severe multicollinearity. Moderate multicollinearity may not be problematic, however, severe multicollinearity is a problem because it can increase the variance of the coefficient estimates and make the estimates very sensitive to minor changes in the model. One or more independent variables which has close relationship can be dropped and standardize the continuous predictor variables.

The F test was used to test the equation model simultaneously. When $P \leq 0.05$, it means that the independent variable simultaneously has a significant effect on the dependent variable. While the t test was partially used to determine whether there was an effect of each independent variable individually on the dependent variable. When $P \leq 0.05$, it means that the dependent variable was significantly affected by individual independent variable.

The Elasticity of Demand

To estimate the elasticity of demand for little tuna, it can be seen from the regression coefficient value of little tuna price variable (X_1) and the price of Indian mackerel as substitute goods (X_3). As stated by Gujarati (1999), the regression coefficient (b) in the log-linear models shows the elasticity of Y to X. The criteria were made as shown in Table 1.

Results and Discussion

Based on the annual report issued by the authority of Kotabaru Fishing Port, the little tuna was the highest rank among the fish production, followed by Indian mackerel, scad, and Spanish mackerel (Table 2). The average prices of the catches ranged from 12,260 to 28,900 IDR per kg (Figure 1). According to Violentina et al., little tuna has a high protein content of 21.6-26.3 g/100 g and it is recommended for health reason [22]. A competitive market price encouraged fishermen to meet the consumer demand by increasing the number of catch, despite it is somewhat complex to balancing between the current fish stock population and socio-economic aspect of local people. On the other hand, the little tuna fishery currently generates positive profits for local fishermen as similarly reported by Yudistira [6].

Table 2: Annual fish production and the prices of commercial pelagic fish landed in Kotabaru Fishing Port, South Kalimantan Province

Type of catch	Fish Production (ton) and Price (IDR/kg)									
	2016		2017		2018		2019		2020	
	Vol	Price	Vol	Price	Vol	Price	Vol	Price	Vol	Price
Little tuna	470.9	15,700	490.5	18,000	435.0	20,500	266.1	31,000	954.3	14,000
Spanish mackerel	440.5	23,000	47.4	19,000	4.0	23,000	18.0	41,500	27.1	38,000
Indian Mackerel	497.7	13,700	342.0	16,000	343.5	19,500	229.1	28,000	471.6	23,000
Scad	313.1	9,600	487.8	6,700	393.0	16,500	71.8	18,500	391.6	10,000

It can be pointed out that there was a relationship between little tuna demand (Y) and independent variables tested (X_1, X_2, and X_3) as shown in the following equation:

$$\text{LnY} = 29.57 + 0.524\text{LnX}_1 - 0.719\text{LnX}_2 - 2.175\text{LnX}_3$$

$R^2 = 64.23\%$, $F = 15.56$, where $| p | 0.000 < 0.01$, and $d = 2.70$

The model clearly showed that more than 64% of variability of little tuna demand was explained by the independent variables; and the rest of 36% was attributed to other variables not included in the model equation. The F test confirmed that the demand for little tuna was simultaneously significantly affected by the said independent variables at a confidence level of 99% ($P < 0.01$). All

estimated relationship between little tuna demand and independent variables tested was described in Table 3.

Further analysis showed that the Durbin-Watson Statistic d = 2.70 falls within an acceptable range, indicating that there was no serial correlation on one or more independent variables, which means that there was no violation of the classic autocorrelation assumption. Then, the VIF value of all independent variables was ranged of 1.12-1.28, which means that model did not exhibit any multicollinearity. It was also clearly revealed that the two independent variables (X_1 and X_2) had no significant effect on the little tuna demand ($P > 0.05$), while another predictor variable in the model (X_3) showed an evidence of a positive relationship ($P < 0.01$). There was a complementary relationship between the prices of little tuna and Indian mackerel, indicating that when the price of little tuna increases, the wholesalers tend to reduce to buy the fish and very likely to buy Indian mackerel when its price decline and to do otherwise. This situation is connected with the idea of Sukirno who emphasized the concept of substitute products [23].

In the investigated area, the fishermen acted as the price taker because all prices of little tuna at any sizes were directly determined by the wholesalers with the same price. In other words, the capital and demand positively and significantly affected income of the fish traders [24]. In this situation, fishermen may not have many options to hold the catches longer due to the highly perishable nature of fish, which leads to greater risk. Otherwise, at the consumer market level, the wholesalers will select and separate the fish by size before selling them to retailers at different price levels. This is the reason behind the price of little tuna at producers and consumers' level did not significantly affect the demand for little tuna. This is different from the fish price system in the province of Surigao Del Sur of the Philippines, where fishermen act as the price makers, the usual practice in buying and selling fish is done directly from the fishing boat to the consumers [7]. Also in Malawi, any size of fish, which is caught by fishermen, finds consumers [11]. Beyond the model, we also observed that the demand for little tuna will also depend on the availability of fish stock provided by fishermen and limit the capital capacity of the wholesalers. It is similarly reported by Gusliza and Winarno for tuna and mackerel scad demand, respectively [25, 26].

C Elasticity of little tuna demand

In the context of demand, elasticity is defined as the degree of sensitivity of goods demanded by consumers due to changes in prices or consumer income. The elasticity of demand can be seen particularly from the price change of little tuna (X_1) and Indian mackerel as substitute goods for little tuna (X_3). The regression coefficient value of 0.524 with the value $| P | 0.227 > 0.05$ in variable X_1 did not cause a significant change in the demand for little tuna. Thus the price elasticity of b = 0, which was categorized perfectly inelastic to the price (ep = 0). While Batoran and Yuliawati reported that the price elasticity of little tuna demand in Gusher market, Tarakan City of North Kalimantan was elastic to the price (ep = 8.96), the same as found in Banjarmasin Fishing Port of South Kalimantan [16, 27]. On the other side, the regression coefficient value of -2.175 with the value $| P | 0.000 < 0.01$ in variable X3 indicates that changes in the price of Indian mackerel as a substitute goods caused a significant change in demand for little tuna. It means that there was very close relationship between the demand for little tuna and Indian mackerel as a complementary variable. According to Sukirno, there are several factors that cause differences in the elasticity of demand for goods, including: (a) the number of substitutes available: the more substitute goods, the more elastic the demand for that goods, (b) percentage of income spent: the greater the share of income needed to buy something, the more elastic the demand for that goods, and (c). timeframe analysis: the longer the period of time the demand is analyzed, the more elastic the nature of the demand for that goods [23]. For the future research, it is strongly recommended to include other predictor variables that might be related to the function of demand, such as capital strength of wholesaler, buyer's income level, fish stock availability, size and quality of fish. Among these, the quality of fish is considered greatly affects to the price value of fish. In particular circumstance, a higher price for middle-upper income people is not very important as long as they can get high quality and fresh fish for health and safety reasons. The availability of fish stocks is also crucial to ensure the continuity of fisheries business and the needs for fish consumption are met while taking preventive measures against overfishing, and the role of traditional knowledge in fisheries management is highly appreciated [28-29].

Conclusion

It can be concluded that the demand for little tuna was significantly affected by the change of the Indian mackerel price alone, while other two predictor variables in the model did not. Since changes in the price of little tuna did not change the demand for little tuna, the price elasticity of demand for little tuna was considered perfectly inelastic. The changes in the prices of little tuna and Indian mackerel are complementary, and the preference is independently selected by the consumers.

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