The Economic Value of Capture Fisheries Service from Coral Reef Ecosystem on Kelapa Dua Island

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ABSTRACT: Coral reefs are critical ecosystems for coastal and marine biota interaction. The coral reef ecosystem on Kelapa Dua, Seribu Islands, is in poor condition with a low live coral cover. This condition decreases fishery productivity, as the coral reef is the habitat and nursery ground for fish and marine biota. The problem in this research is how to increase the percentage of live coral cover on Kelapa Dua Island, so fishermen do not have to fish further to other islands. This study aims to analyze the coral cover percentage and the economic value of the direct use value of capture fisheries services from the coral reef ecosystem on Kelapa Dua Island. The method used in this study to calculate the percentage of coral reef cover is Underwater Photo Transect (UPT) at a depth of 5 meters along 50m at three locations. The method for the capture fisheries data collection is an accidental sampling questionnaire to 30 out of 50 fishermen with a market value approach. The results of this study indicate that the economic valuation of coral capture fisheries services on Kelapa Dua Island per year for fishermen is IDR 394,800,000/US$ 25,165 (1 USD=15,688 IDR) with a coral reef coverage percentage of 12.45%. This value contributes 2.5% of the economic value of capture fisheries services of the coral reef ecosystem in the entire Kepulauan Seribu National Park. This value can be increased by increasing the diversity of types of catch, the biomass of the catch, and the selling price of the catch.

KEYWORDS: Capture Fisheries Services, Coral Reef Ecosystem, Coral Reef Coverage, Economic Valuation, Kelapa Dua Island

I. INTRODUCTION

Environmental economics is derived from two basic sciences: ecology and economics. One of the topics discussed in environmental economics is the allocation of costs for the use of natural resources and the environment to the value of natural resources and the environment itself, to create efficiency, optimality, and sustainability. Environmental economists can view high operational costs as savings and investments due to high efficiency and low risk. These theories are referred to as environmental economic valuations (Common & Stagl, 2005; Parmawati, 2018).

Kelapa Dua Island is a residential island located in the Kepulauan Seribu National Park area. Ideally, the coastal community's livelihood depends on marine production for food security (Rangkuti et al., 2017). According to the research survey, the people did not utilize the marine production of Kelapa Dua Island because the productivity of fishing in these waters is very low. This can be attributed to the poor coral reef coverage. As a result, people tend to fish further away or choose other jobs instead. In fact, fishing in a more distant place or seeking another job is not a sustainable solution and increases job risks.

Research for coral reefs in Kelapa Dua Island has been frequently conducted, and coral reefs in the area can be rehabilitated under various conditions. According to Meidyana et al,. (2021), the survival rate of the Acropora coral transplantation was 65-70%. Nainggolan (2018) and Yudasakti (2010) explained that the overall environmental parameters in Kelapa Dua Island's waters at a depth of 1-4 m are suitable for coral transplantation. The details of the environmental parameters in the area were Salinity = 32 PPT, temperature = 32°C, light intensity = 100%, turbidity= 15 NTU, current speed = 0,08-0,3m/s, sedimentation rate = 2.71-5.82 mg/cm2/day. Yudasakti (2010) also published the result of coral transplantation of Montipora, Porites, and Stylophora on Kelapa Island. The average growth rate of the transplanted corals was 3 cm/month. The

coral transplantation methods that have been done in Kelapa Dua Island waters were concrete, pipe, coral tree nursery, and hexagonal structure.

The economic value of capture fisheries services in the Thousand Islands National Park, in general, has been published by Putri (2009); the amount of the value is IDR9,252,667,729/US$984,326 (US$1=IDR9,400). The focus of this research is to publish: 1) the percentage of coral reef coverage; 2) The economic value of capture fisheries service from the coral reef ecosystem on Kelapa Dua Island; 3) The contribution economic value of capture fisheries from coral reef services in Kelapa Dua Island to Kepulauan Seribu National Park.

II. MATERIALS AND METHODS

The approach used in this research was quantitative. The economic value of capture fisheries was obtained by conducting questionnaires using a market value approach to residents who had carried out fishing activities. The number of respondents obtained was 30. The stages in this research questionnaire are:

- Filling out questionnaires by respondents
- Processing data using descriptive statistics
- Presenting data in tables and analysis

The economic value from the capture fisheries service is calculated using the following formula:

$$Ji = (P \times Ht \times Hj) - Bo \times 12 \ Month$$

Ji = Economic Value of Capture Fisheries Service
P = Fishermen Population
Ht = Average catch per month (Kg)
Hj = Commodities Selling Price (Rp)
Bo = Operating costs (Rp)

Coral reef cover data was obtained using the underwater photo transect (UPT) method. The tools used during the research includes diving equipment, an Olympus Tg-4 underwater camera with a housing, a phone with underwater gear and the GPS Track application, an underwater compass, a 50cm x 60cm photo frame, a 50m long transect, and a laptop with *Coral Point Count* 4.1 software.

Data collection was carried out with two divers; diver 1 was in charge of spreading a 50m transect parallel to the shoreline at the observation point and returning to place a 50cm x 60cm frame at the beginning of each meter point. Diver 2 was in charge of taking photo frames. The results of this data collection are 150 frames representing 150m of coral reef cover at three different observation points. Observations were made at a depth of 5 meters.

Furthermore, 150 photos of observation frames were transferred to a laptop to analyze the percentage of coral reef cover using *CPCe* 4.1 software. After transferring the photos, the software provided 30 random points for each photo to be manually justified to determine the type of coral reef. After the 4500 points had been justified, a computational percentage of coral reef cover was obtained.

III. RESULTS AND DISCUSSION

A. Coral Reef Coverage

Based on the ground-check underwater photo transect results, the percentage of live coral cover at three points was obtained, as shown in **figure 1**. The categorization is based on the reference of KEPMEN LH No.4 (2001). Based on the document, the live coral cover is divided into four categories: bad (0-24.9%), moderate (25-49.9%), good (50-74.9%), and excellent (75-100%). The average was taken from these three points to determine the area of live coral cover on Kelapa Dua island, and the result was 12.45% (Bad).

The dominant categories in the southern area of the coral reef were macroalgae (26.7%), dead coral with algae (26.0%), and sand (19.3%). The dominant categories in the northern area of the coral reef were dead coral with algae (39.0%), rock (25.0%), and sand (14.00%). The dominant categories in the western area of the coral reef were rock (43.0%), macroalgae (24.0%), and dead coral with algae (9.0%)

If compared, another residential island in Kepulauan Seribu National Park had a relatively better live coral cover. As a comparison, the coral reef in the north part of Panggang Island had a live coral cover of 27.2% (Prasetyo et al., 2018). Pramuka Island had a live coral cover of 72.38% (Permana et al., 2020). Kelapa Island had a live coral cover of 55.83% (Mutahari et al., 2019).

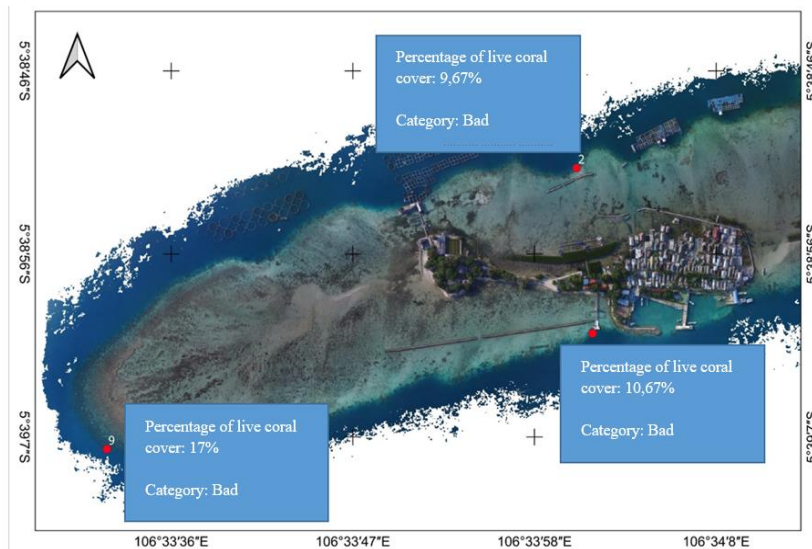**The Economic Value of Capture Fisheries Service from Coral Reef Ecosystem on Kelapa Dua Island**

Figure 1. Aerial Photo and Percentage of Live Coral Cover on Kelapa Dua Island

B. The Economic Value of Captured Fisheries

Based on the questionnaires distributed, the results of the profiles of fishermen on Kelapa Dua Island are as follows:
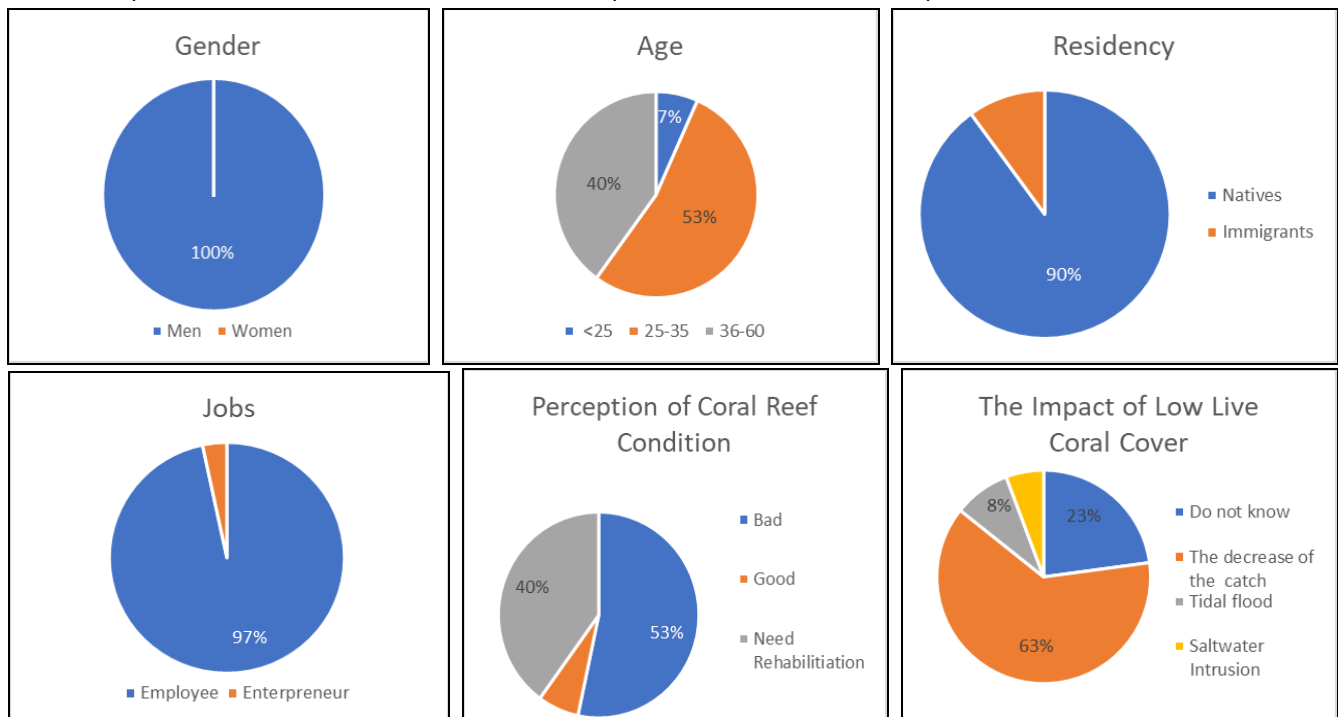

Figure 2. The Results of the Profiles of Fishermen on Kelapa Dua Island Based on the Distributed Questionnaires

The figure above shows that most of the fishermen on Kelapa Dua Island are indigenous people with a primary job as an employee. They fish in the area of Kelapa Dua Island to fill their free time and look for additional income. According to the fishermen's perception, the coral reefs in the Kelapa Dua Island area were in bad condition and had caused a decrease in catches. The target catch for the fishermen in Kelapa Dua Island is squid. The fishing gear used is a fishing line. In detail, the catch on Kelapa Dua Island is as follows:

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Table I. The Questionnaire Results of the Catch on Kelapa Dua Island

No	Questions	Dominant Answers
1	Do you fish every day?	Uncertain
2	How many days do you fish in a week?	Uncertain, at least one day, maximum of seven days if it is squid season.
3	What is the maximum catch per day?	Uncertain
4	What is the minimum catch per day?	0 kg / no catch at all
5	How many catches do you get in a month?	10kg – 15 kg per person
6	What causes you not to fish?	Fishing elsewhere Overtime work Big waves (west season)
7	What are the catch targets on Kelapa Dua Island?	Only squid
8	What is the purpose of fishing?	To be eaten and sold for income
9	How much is the operational cost of fishing for a month?	IDR0 – IDR200,000, an average of IDR 100,000
10	What is the selling price of the caught squid?	IDR55,000
11	Where are the caught squid sold?	Sold to collectors Sold to food handlers
12	How many is the population of fishermen on Kelapa Dua Island?	Less than 50 people

Based on these data, it can be concluded that the average monthly squid catch is 12.5 kg with a selling price of IDR 55,000 per kg. The fishing operational cost per month is IDR 100,000. If it is assumed that there are 50 fishermen on Kelapa Dua Island, then the economic value of the capture fisheries of the coral reef ecosystem on Kelapa Dua Island is:

$$Ji = (P \times Ht \times Hj) - Bo \times 12\ Month$$

Ji = (50 people X 12,5 kg X Rp55,000) – Rp100,000) x 12 Month

Ji = IDR394,800/US$25,165 (USD 1 =IDR 15.688)

When compared with the economic value of capture fisheries in the entire Thousand Islands National Park area (US$ 984,326 (Putri, 2009)), Kelapa Dua Island contributed 2.6% of the value. This could be a reason why Kelapa Dua Island is not used as the main fishing area and the Kelapa Dua Island community does not rely on marine products as their main source of livelihood.

Based on (Putri, 2009) the high value of fishery services obtained is due to the more diverse types of catch, the higher biomass of the catch, and the higher selling price of the catch. The catch obtained in other places is not only squid but also Barracuda, Leopard Grouper, Grouper, Rabbitfish, Snapper, Mackarel Tuna, Pomfret, and so on. It can be sold at a high value. The capture biomass is also higher; it is around 30-100 kg/day.

If the economic value of capture fish services of coral reef in Kelapa Dua Island is to be increased in order to support the needs of the community, then the main solution is to restore the fish population. Restoring fish populations can be done by rehabilitating coral reefs which serve as the habitat and nursery ground for fish and marine biota. The percentage of coral reef cover greatly affects the fish population in the water. Another solution to increase the economic value of coral reef fishing services on Kelapa Dua Island is to process the catch into more valuable goods or create cultivation.

IV. CONCLUSION

This study concluded that the economic value of reef fishing services on Kelapa Dua Island per year for fishermen can be calculated at a value of IDR 394,800/USD 25,165. This value can be increased by increasing the diversity of types of catch, the biomass of the catch, and the selling price of the catch. Increasing catch biomass and diversity can be achieved by improving the percentage of coral reef cover and cultivating, while an increase in the selling price of catches can be achieved by processing catches into more valuable goods.

ACKNOWLEDGMENT

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