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Technical-Economic Characteristics of Small-Scale Troll Line Fishing in the Small Island Park Conservation Area of Kei Kecil, Southeast Maluku Regency

Karakteristik Teknis-Ekonomi Perikanan Pancing Tonda Skala Kecil di Kawasan Konservasi Taman Pulau Kecil Kei Kecil Kabupaten Maluku Tenggara

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Abstract

The troll line fishery developing in the TPK Kei Kecil conservation area is a small-scale fishery consisting of 2 types, bottom and surface troll line. Both kinds of troll lines have technical differences. These technical differences will impact the type of catch and income of the troll line fishermen. This study examines the technological-economic characteristics of small-scale surface and bottom troll line fisheries in the TPK Kei Kecil conservation area. Primary and secondary data are needed, and the data is collected using a survey method with triangulation techniques. The analysis used is qualitative descriptive analysis for the technological aspect and quantitative analysis for the economic aspect. The analysis results show that the construction of surface and bottom troll line fishing technology has differences in ship construction, fishing gear, fishing methods, and different fishing seasons, as well as impacts on the types of target fish. Economically, bottom troll line fishing using a 15 HP outboard motor propulsion is more economical in the west season, and surface troll line fishing using a 15 HP outboard motor propulsion and 6.5 HP trolling is more economical in the east season; therefore, troll line fishing fisheries management needs to be carried out adaptively.

Keywords: Catch, Troll line, Income, Technology.

Abstrak

Perikanan pancing tonda yang berkembang di kawasan konservasi TPK Kei kecil merupakan perikanan skala kecil yang terdiri dari 2 jenis yakni pancing tonda dasar dan permukaan, kedua jenis pancing tonda ini memiliki perbedaan secara terknis. Perbedaan teknis ini akan berdampak pada jenis hasil tangkapan dan pendapatan nelayan pancing tonda tersebut. Penelitian ini bertujuan untuk mengkaji karaktersitik teknologi-ekonomi perikanan pancing tonda permukaan dan dasar skala kecil di kawasan konservasi TPK Kei kecil. Jenis data yang dibutuhkan adalah data primer dan sekunder, data dikumpulkan menggunakan metode survei dengan teknik triangulasi. Analisis yang digunakan adalah analisis deskriptif kualitatif untuk aspek teknologi dan kuantitatif bagi aspek ekonomi. Hasil analisis menunjukan bahwa konstruksi teknologi perikanan pancing tonda permukaan dan dasar memliki perbedaan konstuksi kapal, alat tangkap, metode penangkapan, musim penangkapan yang berbeda dan berdampak pada jenis ikan target, secara ekonomi pancing tonda dasar yang

menggunakan tenaga penggerak motor tempel 15 PK lebih ekonomis pada musim barat dan pancing tonda permukaan yang menggunakan tenaga penggerak motor tempel 15 Pk dan ketinting 6.5 PK lebih ekonomis pada musim timur karena itu pengelolaan perikanan pancing tonda perlu dilakukan secara adaptif.

Kata kunci: Hasil tangkapan, Pancing tonda, Pendapatan, Teknologi.

1. Introduction

The Kei Kecil Island Park (TPK) conservation area is one of the conservation areas in Maluku, located in the western part of Kei Kecil island, Southeast Maluku Regency, which has a capture fisheries sub-zone area of 113,919.73 ha. The conservation area is a potential and economical fishing ground for small-scale fleets. The characteristics of small-scale fishing fleets in the Kei Kecil TPK conservation area are close to the *fishing base*, low operational costs, high economic value catches, and fish resources influenced by the season (Picaulima et al., 2024). The small-scale fisheries fleets operating in conservation are drift nets, single-vessel purse seines, fishing rods, nets, longlines, and arrows. The troll line fleet is one of the small-scale fishing fleets operating every season in the small Kei TPK conservation area.

The fishing gear includes the tonda fishing rod, which consists of a rope, hook, bait, and rope winder. The tonda fishing fleet developed in the small Kei TPK conservation area has a capacity of < 2 GT (Gross Tonage) using simple technology, namely 6.5 PK ketinting and 15 PK outboard motor, so it is classified as a small-scale capture fishery. The tonda fishing gear in operation is active on the surface and bottom of the water, using artificial bait and fresh fish to catch pelagic and demersal fish. Based on the fishing target, technically, the small-scale tonda fishing fishery in the small Kei TPK conservation area differs in boat and gear construction, fishing methods, driving force, and fishing season.

Small-scale tonda fishing in the Kei Kecil TPK conservation area is a capture fishery activity that uses inputs, namely fishermen, boats, and fishing gear, to maximize output and profits. Therefore, tonda fishing is an economic fishery production activity. The economics of small-scale capture fisheries production is an activity that aims to transform the production input sub-system into efficient and effective fisheries production outputs (Picaulima et al., 2023). Therefore, the capture fisheries business is a production activity with economic value and consists of fishermen, boats, fishing gear, and the availability of target fish resources (Susanto et al., 2021). As an economic production activity, small-scale fishers always strive to increase income in each fishing operation to cover all operational costs. Therefore, differences in the technical aspects of small-scale tonda fishing rods that develop in the small Kei TPK conservation area will impact the economic aspects of small-scale capture fisheries. Differences in technical aspects affect the type and amount of catch (Supriadi et al., 2021). Different types and amounts of catch will affect fishermen's income (Suharyanto et al., 2020).

Research related to small-scale tonda fishing fleets and small Kei TPK conservation areas that have been carried out previously relate to the characteristics of FAD-based tonda fishing (Hidayat et al., 2014); madidihang catches from the technical and biological aspects of the tonda fishing fleet (Ihsan et al., 2017); kuwe (*Caranx* sp.) fishing techniques with tonda fishing rods (Katiandago et al., 2022); analysis of the fishing business of the tonda fishing fleet (Baihaqi & Annida, 2017); kuwe fishing techniques with tonda fishing rods (Katiandago et al., 2022); analysis of the fishing business of the tonda fishing fleet (Baihaqi & Annida, 2024); technical and financial aspects of the driftnet business in the Kei kecil TPK conservation area (Notanubun et al., 2021); economic production of longline fisheries in the Kei kecil TPK conservation area (Picaulima et al., 2024). Research related to differences in fleet construction, fishing methods, catches, operational costs, efficiency, effectiveness, and income of small-scale tonda fishing fisheries that develop in the small Kei TPK conservation area each season has never been carried out. Differences in the technical aspects of the fishery will impact the operational costs incurred and the income earned (Mohalisi, 2011; Notanubun et al., 2021). Therefore, studying the technical-economic characteristics of small-scale tonda fishing in the Kei Kecil TPK conservation area is vital for managing and developing small-scale capture fisheries. This study aims to determine the characteristics of the technical and economic aspects of small-scale tonda fishing fisheries operated on surface and bottom waters using 6.5 PK ketinting and 15 PK outboard motor technology in the Kei Kecil TPK conservation area of Southeast Maluku Regency. The benefits of this research are that it can provide important data and information for the government as a fisheries manager in managing and developing small-scale tonda fishing fisheries to improve the economy of coastal communities in the small Kei TPK conservation area of Southeast Maluku Regency.

2. Materials and Methods

2.1. Time and Place

This research was conducted from May 2023 to January 2024. The research locations were Ohoi Selayar, Manyeuw Subdistrict, Ohoi Dian Pulau, Ohoi Ngursit, Hoat Sorbay Subdistrict, and Ohoi Ur Pulau, West Kei Kecil Subdistrict, Southeast Maluku Regency (Figure 1). The four Ohoi were selected as research sites because the waters of the Kei Kecil TPK conservation area are potential fishing grounds for these small-scale surface and bottom trolling fishermen and have been for a long time.

Figure 1. Research location map

2.2. Types and Sources of Data

This research uses several tools, namely writing instruments, including pens, markers, and pencils, used to record data and information related to research, sound recording devices, namely tape recorders, to record information from respondents in the field, and digital cameras to document research results. Materials used include questionnaires, a list of questions for respondents, and notepads as a record file for observations and interviews in the field.

2.3. Data Collection

The data collected in this study used a *survey* method. The data collection technique used was the triangulation method. Triangulation is data collection that integrates three techniques: observation, interview, and document analysis (Sitorus, 1998). The sample was determined based on purposive sampling technique of small-scale bottom and surface tonda fishermen, the respondents' requirements were willing to be interviewed, residing and fishing areas around the small Kei TPK conservation area every season, having experience as a tonda fisherman for more than five years, having a tonda fishing fleet capacity of less than 10 GT. The number of samples in this study was 25 units of a small-scale tonda fishing fleet consisting of 10 basic tonda fishermen and 15 surface tonda fishermen using 6.5 PK ketinting propulsion and 15 PK outboard motor scattered in 4 coastal Ohoi within the Kei Kecil TPK conservation area. The data that has been collected is then processed and analyzed, and then presented in the form of figures and tables, and a comparative descriptive discussion is carried out.

2.4. Data Analysis

The data analyzed in this study used qualitative and quantitative descriptive analysis methods. Qualitative descriptive analysis was used to diagnose technical aspects, including fishing gear construction, vessel and engine size, fishing gear operation methods, fishing areas and seasons, types, and catches. Quantitative descriptive analysis analyzes economic aspects, including total business revenue, productivity, total business capture costs, production cost efficiency, production effectiveness, and business profits. Qualitative and quantitative descriptive analysis methods are as follows:

2.4.1. Fishing Area Analysis of the Small-Scale Tonda Fishing Fleet

Analysis of the identification of fishing grounds of small-scale tonda fishing fleets in each season in the Kei Kei small TPK conservation area was carried out through grid maps and shown by data collectors to small-scale fishermen as owners of small-scale tonda fishing fleets, then the small fishermen marked the fishing grounds in each season. The marked grid map was then transformed into Arc Map software to get a picture of the fishing grounds of the small-scale tonda fishing fleet each season in the small Kei Kei TPK conservation area.

2.4.2. Profit Analysis of a Small-Scale Tonda Fishing Fleet Business

The profit analysis was conducted to determine how much profit the small-scale tonda fishing fleet operating in the small Kei Kei TPK conservation area is currently making. The profit analysis of the fishing business is formulated from the total revenue and total costs (Picaulima et al., 2024). The formula is:

Total revenue of the tonda fishing business: $TR = Q.P$

Description:
TR = Total revenue of tonda fishing business in each season (IDR)
P = Average selling price of fish in each season (IDR /kg)
Q = Average fish production amount of the tonda fishing rod fishery in each season (kg)

Total fishing cost of tonda line fishery: $TC = TVC + TFCE$
Description:
TC = Total fishing cost of tonda fishing in each season (IDR)
TFC = Total fixed costs of the tonda fishing business in each season (IDR)
TVC = Total variable cost of the tonda fishing business in each season (IDR)

Productivity of tonda fishing business: $Pr = TR/TC$
Description:
Pr = Productivity (IDR/season)
TR = Total revenue (IDR/season)
TC = Total fishing operational cost (IDR/season)

Conditions: The magnitude of the Productivity number (Pr) is greater than one (1) or P>1.

Profitability of the tonda fishing business: $\pi = TR - TC$
Description:
Π = Net profit of tonda fishing business in each season (IDR)
TR = Total revenue of tonda fishing business in each season (IDR)
TC = Total cost of catching a tonda fishing rod in each season (IDR)

2.4.3. Analysis of the Production Cost Efficiency of Small-Scale Tonda Fishing Fleet

The production cost efficiency analysis was conducted to determine the minimum production costs incurred by small-scale fishers in the production process of the small-scale tonda fishing fleet operating in the Kei Kei TPK conservation area in each season to produce a certain amount of output. Efficiency analysis using the formula quoted from (Kasim et al., 2021; Picaulima et al., 2024), the formula is as follows:

$$Ef = \frac{TC}{Q}$$

Description:
Ef = Production cost efficiency of the tonda fishing rod fishery in each season (IDR /kg)
TC = Total cost of catching a tonda fishing rod in each season (IDR)
Q = Total production of the tonda fishing business in each season (kg)

2.4.4. Business Effectiveness Analysis of a Small-Scale Tonda Fishing Fleet

Production effectiveness analysis is conducted to determine the output level produced in the production process of the small-scale tonda fishing fleet each season in the current small Kei Kei TPK conservation area. The effectiveness analysis uses a formula quoted from (Kasim et al., 2021; Picaulima et al., 2024). The formula is as follows:

$$EV = \frac{Q}{TC}$$

Description:
Ev = effectiveness of tonda fishing production in each season (kg/IDR)
Q = Total production of tonda fishing rod in each season (kg)
TC = Total fishing cost of tonda fishing in each season (IDR)

3. Result and Discussion

3.1. Small-scale Troll Line Fishing Vessel

The boats used by small-scale tonda fishermen in the Kei Kecil TPK conservation area in surface tonda fishing operations for pelagic fish have a capacity of < 2 GT and are grouped into boats without motors and outboard motor boats. Motorless boats (PTM) have a length (L) of 3-5 m, width (B) 0.40-0.60 m, height (D) 0.3-0.6 m, while outboard motor boats (PMT) have a length (L) of 5-9 m, width (B) 0.50-1 m, height (D) 0.6-0.8 m (Table 1). Generally, the length of boats in small-scale fisheries is less than 12 m (Rufino et al., 2023). The ship has a propulsion power of 5.5-7.5 PK or 15 PK, and the one-piece branded Yamaha uses gasoline and oil (Figure 2).

Vessels used by Kei small-scale fishermen in basic tonda fishing operations have a capacity of < 2 GT and are grouped into outboard motor boats (Figure 2), the size of outboard motor boats (PMT) has a length (L) of 7-9 m,

width (B) 0.50-1 m, height (D) 0.6-0.8 m (Table 1). The boat uses a driving force of 5.5-7.5 PK or 15 PK 1 piece branded Yamaha using fuel, namely gasoline and oil (Figure 2).

Table 1. Size of a tonda fishing vessel based on propulsion power

No.	Drive Power	Surface Tonda Fishing Line			Basic Tonda Fishing Line		
		Length (m)	Width (m)	Height (m)	Length (m)	Width (m)	Height (m)
1.	Ketinting	3-5	0.40-0.60	0.30-0.60	-	-	-
2.	Outboard Motor	5-9	0.50-1.00	0.60-0.80	7-9	0.50-1.00	0.60-0.80

(a) 15 PK basic tonda fishing rod (b) 6.5 PK surface tonda fishing rod (c) 15 PK surface tonda fishing rod

Figure 2. Small-scale bottom and surface tonda fishing vessel

Vessels/boats for demersal fish tonda fishing (live grouper) are equipped with a water exchange hole in the center of the vessel/boat to keep the caught grouper alive until it reaches the buyer.

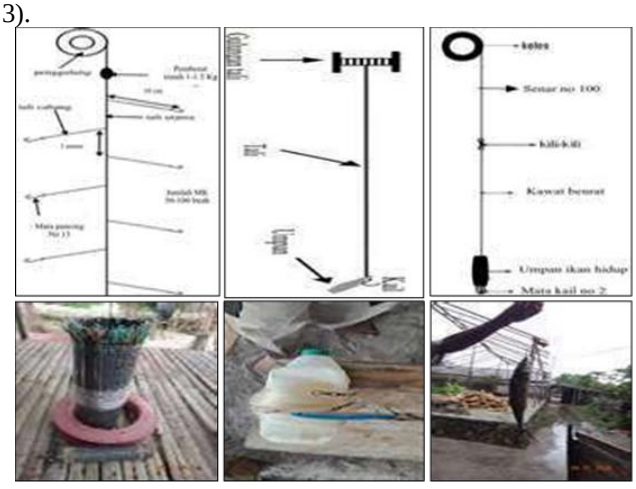
3.2. Small-scale Troll Line Fishing Gear

The construction of surface and bottom tonda fishing gear is different, and fishermen make both fishing rods according to the fishing method and the desired target catch. The construction of basic tonda fishing gear consists of 3 parts, namely: 1) 40 m long benrat wire, 2) string number 30-40, 1.80 m long, 3) artificial bait made of plastic fiber and orange plastic sheeting with hook number 6-7 (Figure 3). The color and sparkle of artificial bait made from synthetic materials and motion in water cause fish to be easily attracted (Baskoro et al., 2011).

a b c

Figure 3. Construction of small-scale basic tonda fishing gear (a and b) and fish holding cone basket (c)

Another means of capture used in supporting this fishing activity is a cone-shaped basket that serves as a temporary shelter for live grouper before being put into the tub in the boat. The basket consists of a buoy, the rope connecting the buoy to the basket is 10 m long, the mesh size is 1 cm, the basket diameter is 40-50 cm, and a 2-3 kg weight is used (Figure 3).



a b c

Figure 4. Construction of small-scale basic tonda fishing gear with artificial bait (a and b) and fresh fish bait (c)

Construction of surface tonda fishing gear using artificial bait consists of plastic fibers, rubber and plastic sheets tied to number 13 hooks numbering 50-100 pieces, has a PA mono snar size no 15-20 as the main string with a length of > 100 meters, the length of the connecting string between the hook and the main string is 10 cm, the distance between the hooks is 1 m. Using a weight made of lead on the top weighing 1-1.5 Kg. The roll string is made of plastic, and the string connecting the sinker to the roll is > 100 meters long and number 50, and uses kili-kili at the top and bottom of the sinker (Figure 4). The dimensions of the tonda fishing tool that uses live bait, namely momar fish, komo children, kawalinya, tied to hook number 2, have a PA mono snare size number. 100 as the main string and a 1-m-long benrat wire that is directly connected to the eye of the river that has been tied with live bait, and to connect the strings and wires, kili-kili (Figure 4).

3.3. Catching Operation Method of Small-scale Troll Line Fishery

The small-scale bottom fishing rods operated in the Kei Kecil TPK conservation area are surface and bottom fishing rods. Both fishing lines are active. Therefore, the fishing operations consist of three stages, but they differ in the time of operation, season, and fishing method (Figure 5). According to Katiandagho et al. (2022), the stages of tonda fishing operations consist of preparation, setting, and hauling. Preparation is the first stage that a fisherman must carry out, including the engine, fuel, fishing gear, ice, and fish shelter before heading to the fishing ground for the surface tonda fishing fleet at 09.00 WIT and the basic tonda fishing fleet at 14.00 WIT. The fishing operations of both Tonda fishing fleets are carried out during the day so that the reflection of sunlight can hit artificial bait and fresh fish, which is more easily seen by pelagic and demersal fish actively looking for food during the day.

Figure 5. Stages of small-scale tonda fishing line operation

Setting fishing gear is done after arriving at the fishing ground. For surface tonda fishing rods that use fresh fish bait, the setting process begins with installing fresh fish bait prepared for the fishing eye. In contrast, tonda fishing rods that use artificial bait on both basic and surface tonda fishing rods immediately lower the fishing gear into the water while running the boat, for surface tonda fishing the length of the strings that are stretched between 5 to 10 meters with the position of the boat in front or next to the schools of pelagic fish. In contrast, the basic tonda fishing artificial bait is stretched until it is above the rock where demersal fish take shelter then menonda (pulling) the fishing line on the back side of the ship that has been stretched into the waters along the water area until the target fish is caught, the speed of the ship for basic tonda fishing is lower than surface tonda fishing. Furthermore, hauling is the process of lifting the catch after the engine speed is stopped then pulling the fishing line along with the catch into the fishing boat and releasing it from the fishing line, for live grouper before being put into a container that has filled with salt water in the boat the fish must be put into a collection basket (cone-shaped) while pelagic fish and demersal fish that have died are placed into the box. The stages of setting to hauling are repeated while at the fishing ground. The number of crew members in surface and bottom tonda fishing operations is one person who serves as helmsman and angler while in charge of seeing signs of the presence of target fish.

3.4. Fishing Areas and Seasons for Small-scale Troll Line Fisheries

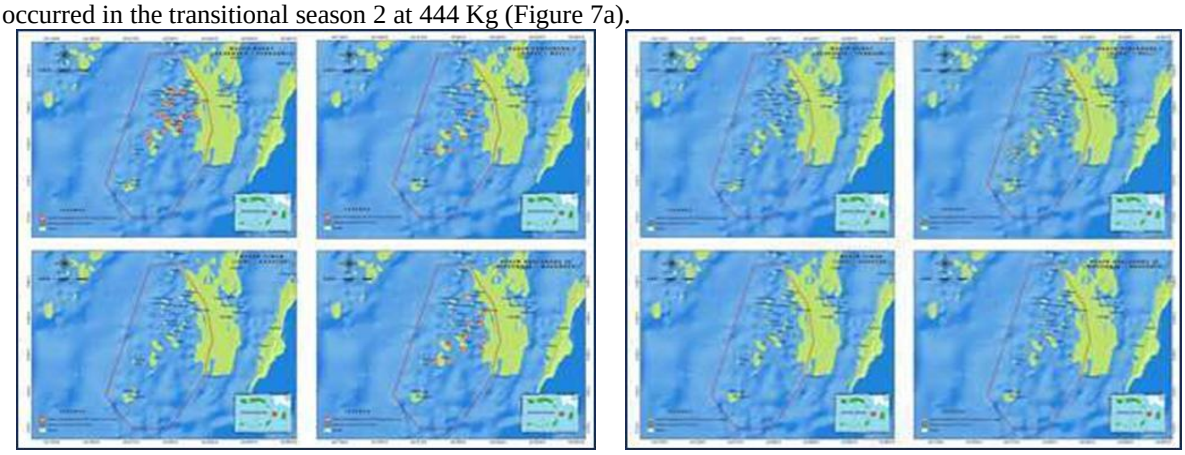
The season strongly influences the fishing grounds of surface and bottom tonda fishing fleets in the waters of the Kei Kecil TPK conservation area. Environmental factors generally influence changes in fishing grounds each season because fish are more likely to be in habitats or environments that provide food, reproduction, and ease of migration (Waileruny et al., 2014). Figure 6a shows that the fishing grounds of the basic tonda fishing fleet in the transitional season 2 (week 2 or 4 of November) are in the waters around the five islands of Tarwa Island, Manir Island, Waha Island, and the waters of Ur Island, Witir Island, and Ten Island. In the western season, the fishing grounds are close to the coast in the waters of Lima Island, namely Manir Island, Tarwa, Liik, and parts of Ten Island, namely Tarwa Island, as well as Ur and Witir Islands. In the first transitional season (week 2 or 3 of March), the fishing grounds are still the same as the previous season in the waters of the conservation area, starting from Ur Island, the warbal area of the Five Island waters (Manir Island, Warbal, Tarwa, Liik, and Labulin), and the waters of the Ten Island area, namely Ohoiwa and Ohoitir.

Figure 6b shows that in the west season, fishing operations are carried out in the coastal waters of Ur and Witir Islands and the waters between Witir, Ur, and Nuhuta Islands, Ten Island waters, some of the waters of Pulau Lima, this condition continues in the east season and transitional season 2. In the second transitional season, the fishing grounds spread south of the small Kei TPK conservation area, namely the waters of Nuhuta Island and Tanimbar Kei.

3.5. Types and Catches of Small-scale Troll Line Fisheries

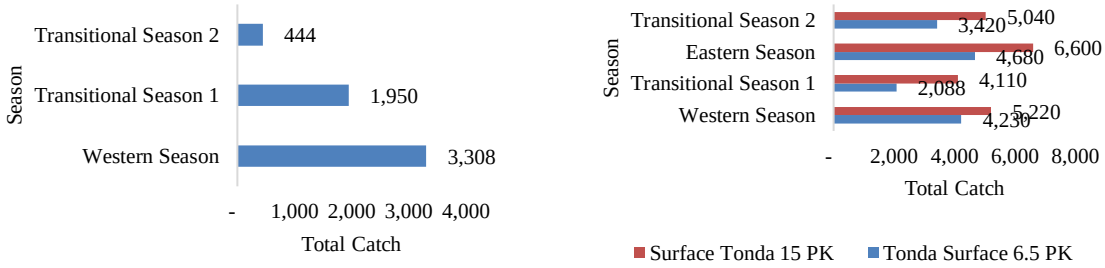
The catches of small-scale bottom and surface trolling fleets operating in the waters of the small Kei TPK conservation area fluctuate each season. Fluctuations and variations in tonda fishing catches are strongly

influenced by seasonal factors, where the season correlates with monsoon wind patterns (Wahju et al., 2013). The main catches of the basic tonda fishing fleet are live grouper (*Epinephelus* sp), sikuda (*Lethrinus* sp), bubara (*Caranx* sp), red snapper (*Lutjanus* sp), while the bycatch is barracuda (*Sphyraena barracuda*). The highest catch of the basic tonda fishing fleet occurred in the west season at 3,303 Kg. The lowest catch of the fishing fleet occurred in the transitional season 2 at 444 Kg (Figure 7a).



(a) (b)

Figure 6. Fishing areas of the bottom tonda fishing fleet (a) and surface tonda fishing fleet (b) in Kei Kecil TPK conservation area in each season



(a) (b)

Figure 7. Total catches of small-scale bottom (a) and surface (b) tonda line fisheries in Kei Kecil TPK Conservation Area in each season

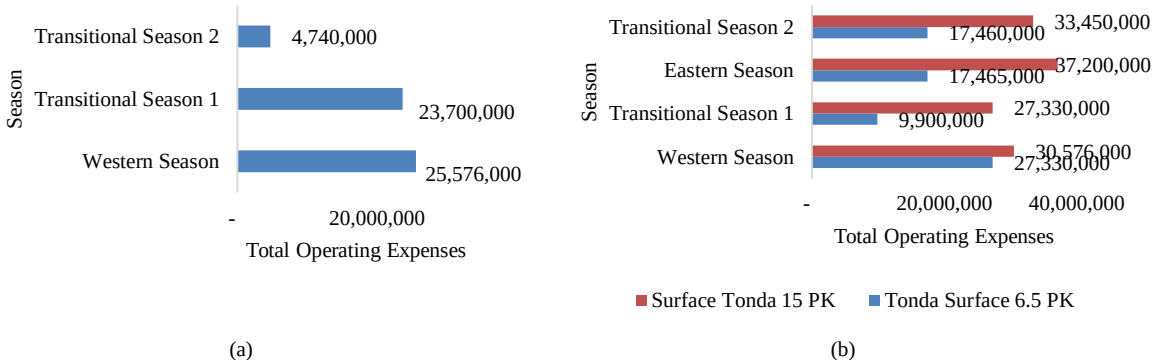
The dominant catches of surface tonda fishing are bubara (*Caranx sp*), barracuda (*S. barracuda*), and komo (*Auxis thazard*). The highest catch of surface tonda fishing fleet using a 15 PK outboard motor occurred in the east season at 6,600 Kg, while for 6.5 PK ketinting it also happened in the east season at 4,650 Kg. The lowest catch of the surface trolling fishing fleet using a 15 PK outboard motor occurred in the Pancaroba 1 season at 4,110 Kg, while for 6.5 PK ketinting it also happened in the east season at 2,088 Kg (Figure 7b).

3.6. Total Operational Cost of Small-scale Troll Line Fishing Fleet

The operational costs of small-scale bottom and surface tuna fishing fleets differ each season. The operational costs in each season are determined by the fixed and variable cost components incurred to obtain the catch (Picaulima et al., 2023). Figure 8a shows that the highest operational cost of the basic tonda fishing fleet occurred in the west season, amounting to IDR 25,576,000. The lowest operational cost of the basic tonda fishing fleet occurred in the transitional season 2, amounting to IDR 4,740,000. Meanwhile, Figure 8b shows that the highest operational cost of the surface tonda fishing fleet using a 15 PK outboard motor occurred in the east season at IDR 37,200,000, while for 6.5 PK ketinting it also happened in the east season at IDR 17,465,000. The lowest total catch of the surface tonda fishing fleet using a 15 PK outboard motor occurred in the transitional season 1, amounting to IDR 27,330,000, while for 6.5 PK ketinting it also occurred in the transitional season 1, amounting to 9,900,000.

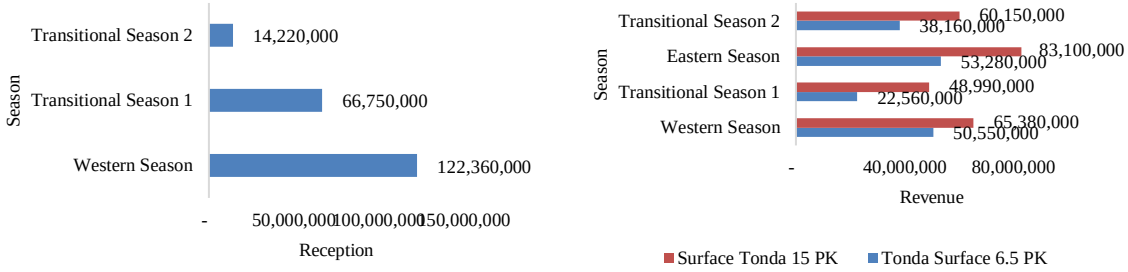
3.7. Total Revenue of Small-scale Troll Line Fishing Fleet

The revenue of small-scale basic and surface tonda fishing fleets differs each season. The amount of revenue fishermen earn each season is influenced by the type and amount of fish caught and the selling price of fish (Ridha, 2017). Figure 9a shows that the highest revenue of the basic tonda fishing fleet occurred in the west season, amounting to IDR 122,360,000. The lowest revenue for the basic tonda fishing fleet occurred in the transitional season 2 at IDR 14,220,000.



(a) (b)

Figure 8. Total operational costs of small-scale bottom (a) and surface (b) tonda fishing fleets in the Kei Kecil TPK Conservation Area in each season



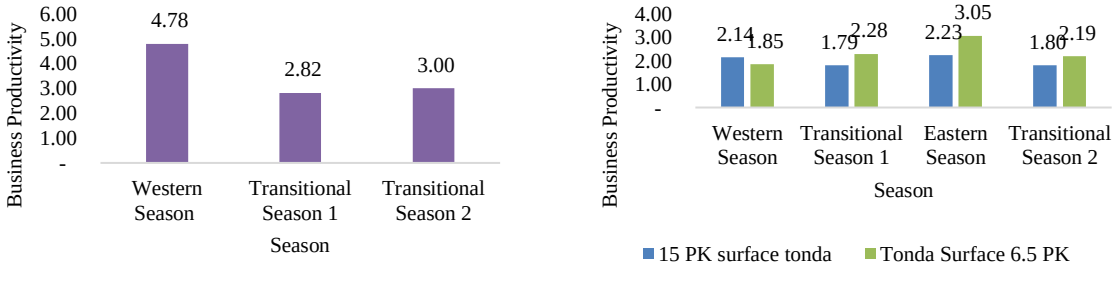
(a) (b)

Figure 9. Number of receipts of small-scale bottom (a) and surface (b) Tonda fishing fleets in Kei Kecil TPK Conservation Area in each season

The highest revenue of the surface tonda fishing fleet using a 15 PK outboard motor occurred in the east season at IDR 83,100,000, while for 6.5 PK ketinting it also happened in the east season at IDR 53,280,000. The lowest revenue of the surface tonda fishing fleet using a 15 PK outboard motor occurred in the transitional season 1 at IDR 49,990,000, while for the 6.5 PK ketinting it also occurred in the transitional season 1 at 22,560,000 (Figure 9b).

3.8. Productivity of Small-scale Troll Line Fishing Fleets

The business productivity of small-scale bottom and surface tuna fishing fleets differs from season to season because revenues and operating costs constantly change each season. Therefore, fishery productivity is high if revenue exceeds the operational costs incurred in a season (La Ola, 2012; Kasim et al., 2021). So, a fishery business can be feasible if it has a high productivity index (Prasetyono et al., 2021). Therefore, productivity is a key economic indicator in measuring the relationship between inputs that produce many outputs (Walden et al., 2015). Figure 10a shows that the highest business productivity of the basic tonda fishing fleet occurred in the west season at 4.78. The lowest effort productivity of the tuna bottom fishing fleet occurred in transitional season 1 at 2.82.



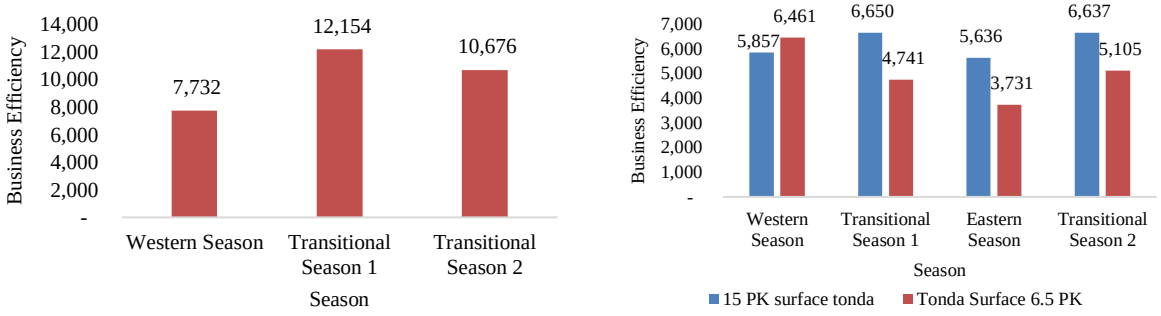
(a) (b)

Figure 10. Productivity of small-scale bottom (a) and surface (b) Tonda fishing fleet in Kei Kecil TPK Conservation Area in each season

Figure 10b shows that the highest business productivity of the small-scale surface tonda fishing fleet using a 15 PK outboard motor occurred in the east season at 2.23, while for 6.5 PK ketinting, it also occurred in the east season at 3.05. The lowest business productivity of the surface tonda fishing fleet using a 15 PK outboard motor occurred in the transitional season 1 at 1.79, while for 6.5 PK ketinting it happened in the west season at 1.85.

3.9. Production Cost Efficiency of Small-scale Troll Line Fishing Fleet

The efficiency of small-scale bottom and surface tuna fishing fleets fluctuates each season. The low value of efficiency in each season will be achieved if the cost of production inputs incurred to obtain the output is very small, in addition to the value of efficiency, which can be used as an indicator to show the cost of sales of fishery products (Picaulima et al., 2023). Figure 11a shows that the lowest business efficiency of the basic tonda fishing fleet occurred in the west season at 7.732. The highest effort effectiveness of the basic tonda fishing fleet occurred in transitional season 1 at 12,154. While the lowest business efficiency of the surface tonda fishing fleet using a 15 PK outboard motor happened in the east season at 5,636, for 6.5 PK ketinting, it also occurred in the east season at 3,731. The highest effort efficiency of the surface tonda fishing fleet using a 15 PK outboard motor occurred in the transitional season 1 at 6,650, while for 6.5 PK ketinting it happened in the west season at 6,461 (Figure 11b).

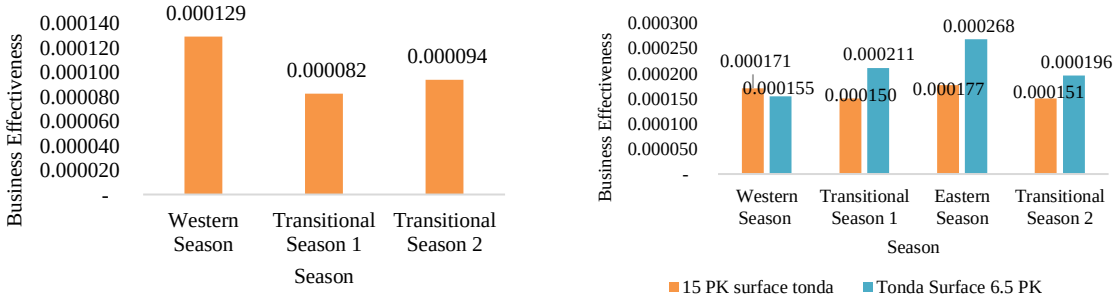


(a) (b)

Figure 11. Productivity of small-scale bottom (a) and surface (b) Tonda fishing fleet in Kei Kecil TPK Conservation Area in each season

3.10. Business Effectiveness of Small-scale Troll Line Fishing Fleets

The business effectiveness of small-scale basic and surface tonda fishing fleets fluctuates each season. The high efficacy of the fishing business in each season is because the output produced is greater than the production costs incurred in the fishing process, so that business profits can be achieved (Picaulima et al., 2023). Figure 12a shows that the highest business effectiveness of the basic tonda fishing fleet occurs in the west season at 0.000129. The lowest business effectiveness of the basic tuna fishing fleet occurred in the transitional season 1 of 0.000082. Figure 12b shows that the highest business effectiveness of the small-scale surface trolling fishing fleet is the surface trolling fishing fleet using a 15 PK outboard motor, occurring in the east season at 0.000177, while for 6.5 PK ketinting it also appears in the east season at 0.000268 (Figure 12b). The lowest effort effectiveness of the surface tonda fishing fleet using a 15 PK outboard motor occurred in the transitional season 1 at 0.000150, while for 6.5 PK ketinting it happened in the west season at 0.000155.

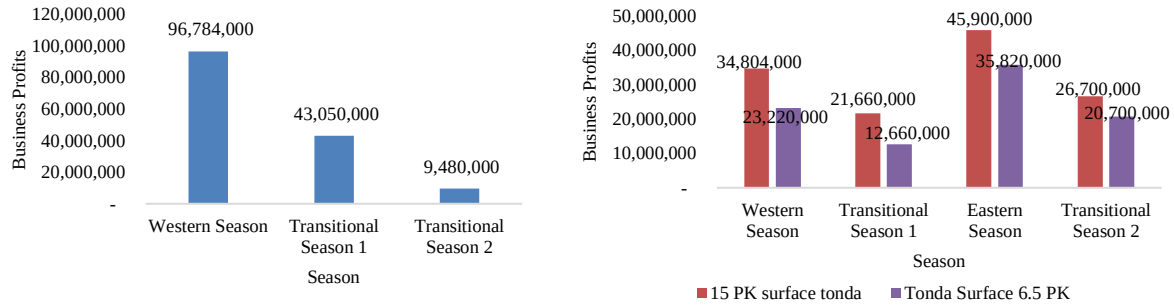


(a) (b)

Figure 12. Business effectiveness of small-scale bottom (a) and surface (b) Tonda fishing fleets in Kei Kecil TPK Conservation Area in each season

3.11. Profitability of Small-scale Troll Line Fishing Fleets

The profitability of small-scale bottom and surface tuna fishing fleets fluctuates each season. The profitability of a fishing business is primarily determined by the size of the revenue obtained in each season and the amount of catch. Therefore, the amount of business profit received shows that the business managed is successful and progressing (Sumiratin & Syarbiah, 2018). Figure 13a shows that the highest business profit of the basic tonda fishing fleet occurred in the west season of IDR 96,784,000. The lowest business profit of the basic tonda fishing fleet occurred in the transitional season 2 of IDR 9,480,000.



(a) (b)

Figure 13. Business profits of small-scale bottom (a) and surface (b) Tonda fishing fleets in Kei Kecil TPK Conservation Area in each season

Meanwhile, Figure 13b shows that the highest business profit of the surface tonda fishing fleet using a 15 PK outboard motor occurred in the east season at IDR 59,900,000, while for the 6.5 PK ketinting it also happened in the east season at IDR 35,820,000. The lowest business profit of the surface tonda fishing fleet using a 15 PK outboard motor occurred in the transitional season 1 of IDR 21,660,000, while for the 6.5 PK ketinting it also occurred in the transitional season 1 of IDR 12,660,000

4. Conclusions

The technological characteristics of the surface and bottom trolling fisheries differ in vessel construction, fishing gear, method, and time of fishing operations, fishing season, and type and amount of catch, but the fishing grounds of both fleets are in the waters of the Kei Kecil TPK conservation area in every season. The economic characteristics of the small-scale tonda fishing fleet operating in the waters of the Kei Kecil TPK conservation area show that the basic tonda fishing fleet using a 15 PK outboard motor is more economical in the west season, while the surface tonda fishing fleet using a 15 PK outboard motor and a 6.5 PK ketinting is more economical in the east season.

5. Suggestion

Maluku Province fisheries managers need to cooperate with bottom and surface tonda fishermen in organizing production inputs based on propulsion in the waters of the small Kei TPK conservation area in the west and east seasons. In the subsequent research, it is necessary to study the utilization and economic sustainability of pelagic and demersal fish resources of small-scale tonda fishing in the small Kei TPK conservation area. The study was conducted to determine the utilization and economic sustainability level of small-scale surface and bottom trolling fisheries in the Kei Kecil TPK conservation area.

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