Analysis of Gillnet Fishery Business for Narrow-Barred Spanish Mackerel and Indo-Pacific Mackerel: Lesson Learned From KUB Kampung Baru in Muara Kintap, Indonesia

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Abstract

This study sheds light on the business sustainability of the gillnet fishery for narrow-barred Spanish mackerel (*Scomberomorus commerson*) and Indo-Pacific mackerel (*Scomberomorus guttatus*), locally called "Tenggiri" and "Kembung," respectively, undertaken by the Kelompok Usaha Bersama (KUB) Kampung Baru, a collective business group in Muara Kintap, Indonesia. Employing a descriptive approach, we analyse the fisher group's financial performance, profitability, marketing channels, gap and challenges. Key findings reveal a thriving operation. Over 327 tons of fresh and dried mackerel were procured across 216 fishing trips involving 18 vessels. Fish prices varied along the supply chain, with producers earning USD1–7 kg^{-1} and wholesalers fetching USD2–8 kg^{-1}. This fisher group generated a substantial annual profit of USD488,346 $year^{-1}$, translating to roughly USD43,882 $vessel^{-1}$ $year^{-1}$. Strong financial indicators further reinforce this success. A healthy return on investment (R/C ratio of 1.48) and a rapid payback period (0.63 years) demonstrate viability. Positive net present value (NPV) of USD1,417,004, net benefit-cost ratio (NetBCR) exceeding 1 (6.91), and an impressive internal rate of return (IRR) of 159 % confirm financial feasibility. Vessel owners enjoyed a substantial monthly income of USD2,438 $trip^{-1}$ $vessel^{-1}$, significantly exceeding the provincial minimum wage of USD172 $month^{-1}$. The producer-wholesaler-consumer marketing channel functioned efficiently, with margins ranging from 9 to 40 % and fishers retaining a significant share (60–91 %). These findings also highlight the under-exploited potential of the mackerel fishery to bolster fishery processing businesses. The fisher group's success story exemplifies the potential for good profit margins, swift returns on investment, and the establishment of sustainable practices within the industry.

Keywords: *Scomberomorus commerson*, *Scomberomorus guttatus*, financial analysis, mackerel fishery, marketing channel, profitability

Introduction

Globally, Indonesia is the second largest fish producer after China with an industry worth an estimated USD27 billion, and home to one of the highest levels of marine biodiversity in the world (Sulistijowati et al., 2023). The fishermen work in some of the richest and most productive marine ecosystems in the world, and fish products account for around 54 % of the nation's animal protein intake. The fisheries industry employs about 12 million people and produces high-quality goods, ensuring the nation's food supply and security (Aryudiawan and Suadi, 2022). Tezzo et al. (2020) emphasised that a production-based focus on fisheries should not obscure access and utilisation dimensions of food security. Meanwhile, the Minister of Marine Affairs and Fisheries announced that the national fish consumption until October 2023, reached 56.48 kg $capita^{-1}$. It is globally recognised that there is still a lack of fish consumption data by species in many countries including Indonesia (Gibson et al., 2021).

This study focuses on two commercially vital pelagic fish species: the narrow-barred Spanish mackerel, *Scomberomorus commerson* (Lacépède, 1800), and the Indo-Pacific mackerel *Scomberomorus guttatus* (Bloch

& Schneider, 1801), known locally as 'Tenggiri' and 'Kembung', respectively. Prized for their taste, thick flesh, and health benefits, these widely distributed fish are a mainstay of Southeast Asian seafood markets, catering to domestic consumption and export due to high demand (Kasim and Triharyuni, 2014; Hosseini et al., 2017; Lubis et al., 2019). Nowadays, perception of consumer preferences for consuming fish for health is highly appreciated (Esilaba et al., 2017). They are rich in protein (19.5 %) and essential lipids (2.27 %) crucial for growth and immunity (Ahmed et al., 2012; Tilami and Sampels, 2017). Recent research has even explored the potential of these fish for flavourful broths derived from the head and bones (Pratama et al., 2019).

Mackerel fisheries in Indonesia play a vital role, employing a significant number of fishers and processors while contributing substantially to the national catch. Diverse fishing gear, including purse seine nets, trawls, drift gillnets, handlines, and longlines, target these species (Jumsurizal et al., 2014; Hosseini et al., 2017; Oktavera et al., 2019). Peak season in March intensifies fishing activity, but concerns exist regarding potential overfishing and its impact on future supply (Kasim and Triharyuni, 2014; Situmorang et al., 2018). To address these concerns, studies continue on the biological, ecological, and socio-economic aspects of the mackerel fishery (Al-Mamry, 2006; Sulaiman and Ovenden, 2010; Roa-Ureta, 2015; Fakhri et al., 2015). Maintaining fish quality and freshness through proper post-harvest handling and distribution systems is paramount (Prasetyo et al., 2018; Lubis et al., 2019). Effective marketing strategies are crucial for both producers and traders to maximise profits. Fish prices are influenced by factors like seasonality, quantity and quality of the catch, type and size of fish, freshness, market dynamics, and distribution channels (Aswathy and Abdussamad, 2013; Begum et al., 2014). Notably, research on the independent collective business groups (KUB) engaged in the mackerel gillnet fishery at a regional level in Indonesia remains scarce.

This research is timely due to concerns about the sustainability of the narrow-barred Spanish mackerel and Indo-Pacific mackerel fishery particularly in Muara Kintap waters, Indonesia. We aim to answer the question: How sustainable is the current gillnet fishery targeting these mackerel species in Kelompok Usaha Bersama (KUB) Kampung Baru? By analysing the fishery's practices and impact, we hope to improve management strategies and contribute valuable data currently lacking for this location. Understanding the KUB Kampung Baru's case can inform sustainable practices in other small-scale fisheries. This research differs from previous articles (Juliani et al., 2019; Helminuddin et al., 2020; Fitria et al., 2021) by focusing on KUB Kampung Baru and employing the financial performance analysis, marketing, and the business model of mackerel gillnet fishery to address the gap in knowledge about the socio-economic factors and community involvement in this fishery.

Materials and Methods

Ethical approval

The research protocol received ethical approval from the Faculty of Marine and Fisheries, Lambung Mangkurat University (Letter No. 455/UN.1.27/AK/2020). This ensured adherence to ethical guidelines before commencing interviews and surveys with KUB members and other stakeholders.

Study site

Research on the gillnet fishery business was focused on the KUB Kampung Baru, located in Muara Kintap Village, Tanah Laut District, South Kalimantan Province of Indonesia (Fig. 1). The KUB (Kelompok Usaha Bersama) was established on 11 November 2015 authorised by the Food Security and Fisheries Service of Tanah Laut District. The number of group member was 11 persons with dependent family member of 2–6 persons. The age of group member was 37–60 years with education background of elementary school (82 %), junior high school (9 %) and senior high school (9 %). The group also received the grant aid from local government and related institution in the form of floating aids, fishing vessels and fishing gear equipment.

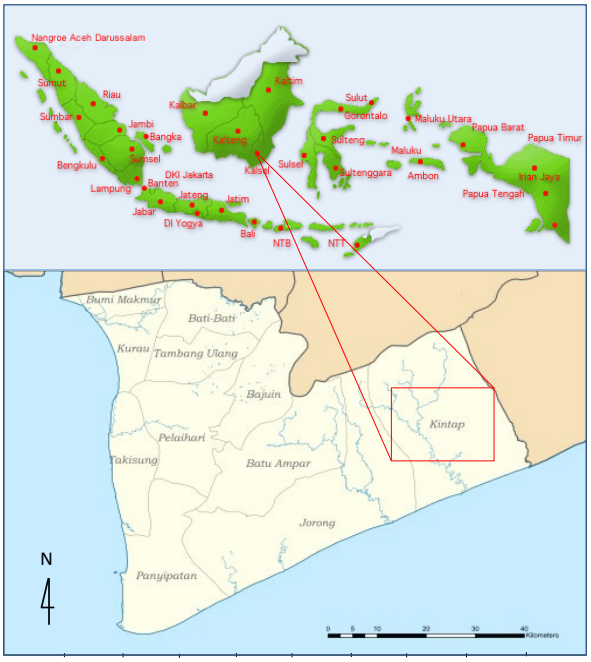

Fig. 1. The location of KUB Kampung Baru at Muara Kintap Village, Tanah Laut District, South Kalimantan, Indonesia.

The KUB utilises a fleet of 18 vessels ranging from 18 to 21 gross tonnage (GT). These vessels operate within 3–6 miles of the Muara Kintap Fishing Port, with some venturing further afield. Each vessel is equipped with modern technology, including GPS, fish finder, and radio communication. Two primary gillnet types were employed: one targeting narrow-barred Spanish mackerel, *S. commerson* (Tenggiri) as the main catch,

and a secondary net for Indo-Pacific mackerel, *S. guttatus* (Kembung). Both nets were made from PA monofilament; the *S. commerson* net uses a larger mesh size (4 inches) compared to the *S. guttatus* net (2¼ inches). As illustrated in Figure 2, individual gillnets range from 300 to 450 m in length and 15 to 20 m mesh depth. Deployment involves directly setting the nets from the boat at depths of 20–25 m. Setting and hauling time for the gear is approximately 1 h, followed by a 9 h soak period typically commencing at 8 pm and concluding by 5 am. The capture process utilising these gillnets is well documented by Hosseini et al. (2017) and Oktavera et al. (2019). While *S. commerson* are targeted year-round, the *S. guttatus* season is confined to the November-April timeframe. Interestingly, the fishing grounds for *S. commerson* extend beyond the immediate vicinity, encompassing areas like Kotabaru, Marabatuan, Sembilan Island, and even reaching Balikpapan and Samarinda of East Kalimantan Province.

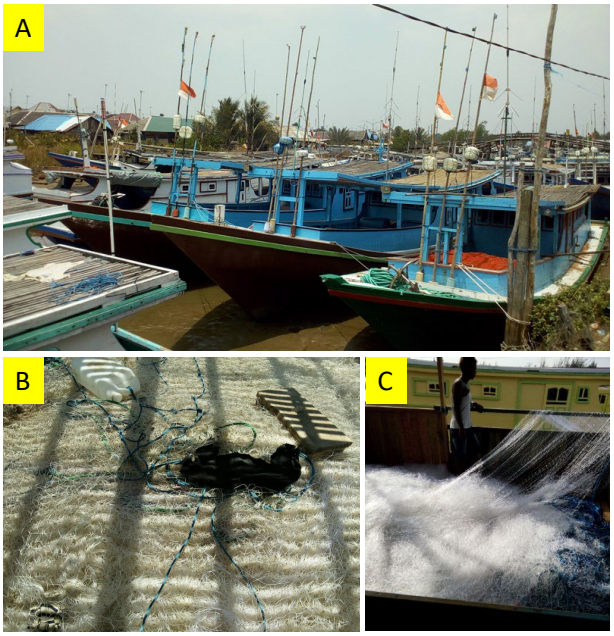

Fig. 2. Characteristics of (A) the fishing fleets of 18-21 GT, (B-C) the gillnets for *Scomberomorus commerson* and *S. guttatus* made of PA monofilament with 4 and 2¼ inches stretched mesh sizes, respectively used in Tanah Laut District, South Kalimantan, Indonesia.

Data collection

The data collected including primary and secondary data. Primary data related to fish production (type and number of catch, number of fishing vessel, fishing trip and type of fishing gear), and financial aspects (the profit, revenue cost ratio, payback period and break-even point) were directly obtained from the ship owners of the KUB and the wholesalers using the structured questionnaires and in-depth interview approach, as well as a direct observation on fish distribution and its marketing channel including estimation of marketing margin and fisher's share. While secondary data were in the form of company profile, literature study and annual reports from the relevant institutions. Data were analysed qualitatively and quantitatively using descriptive method. The results were presented in graphical, verbal or in tabular form. The respondent characteristics and example of structured questionnaire can be seen in Supplementary Table 1.

Data analysis

Profit analysis

Profit is the difference between total revenue and total cost. Mathematically, it is represented as (Riani et al., 2013):

$$\pi = TR - TC \quad (1)$$

where π is profit, TR is total revenue and TC is total cost.

Revenue cost ratio

Revenue cost ratio is the ratio of total revenue and total cost, calculated by using the following formula (Hartini and Sumaryam, 2018):

$$R/C = \frac{\text{Total revenue}}{\text{Total cost}} \quad (2)$$

If R/C >1, business is profitable and has a reasonable prospect of profit. If R/C <1, it is unprofitable or has unreasonable expectation of profit. If R/C = 1, it is at break-event point.

Payback period

Payback period is the time needed to recover the initial cost of an investment, simply calculated by using the formula (Lohmann and Baksh, 1993):

$$\text{Payback period} = \frac{\text{Total investment}}{\text{Profit}} \times 1 \text{ year} \quad (3)$$

The capital return is categorised "fast" if PP <3 years, "moderate" if PP 3-5 years and "slow" if PP >5 years (Fitria et al., 2021). The shorter the payback period, the more attractive the investment, and the more profitable of business.

Return on investment

Return on investment (ROI) is used to measure the effectiveness of an investment. It expresses the percentage gain on the investment. ROI is calculated by dividing the operating profit earned after the investment by the total investment cost (invested capital). The result is then multiplied by 100 (Zamfir et al., 2016).

$$\text{ROI (\%)} = \frac{\text{Profit (after investment)}}{\text{Invested capital}} \times 100 \quad (4)$$

Break-even point

Break-even point (BEP) can be defined as a point where total costs and total revenue are equal. BEP analysis can help determine fixed and variable costs, set prices and plan for business's financial future. It was simply estimated with the formula (Setiawan et al., 2018):

$$\text{Break even point in production} = \frac{\text{Total cost}}{\text{Price per unit}} \quad (5)$$

$$\text{Break even point in price} = \frac{\text{Total cost}}{\text{Total production}} \quad (6)$$

The feasibility of business was determined by the following criteria: the value of BEP in production < number of units produced, and the value of BEP in price < price applicable.

Net present value

Net present value (NPV) is the difference between benefits and costs used as present value. It can be calculated using the following formula (Lohmann and Baksh, 1993):

$$NPV = \sum_{t=1}^{n} \frac{Bt - Ct}{(1+i)^t} \quad (7)$$

where: Bt is benefit in the t-year, Ct is cost in the t-year, i is applicable interest rate, and t is investment period (5 years). If NPV >0, the business is considered feasible, and if NPV ≤0 indicates that the business reaches break-even point or not feasible to be continued.

7. Net benefit cost ratio

Net benefit cost ratio (NetBCR) is the comparison between positive NPV value and negative NPV value. The ratio determines the relationship between the expected incremental benefit from a business and the corresponding costs that would be incurred to complete the business. It can be calculated by using the following formula (Izmaniar et al., 2018):

$$\text{NetBCR} = \frac{\sum_{t=1}^{n} NPV^{+}}{\sum_{t=1}^{n} NPV^{-}} \quad (8)$$

where: NPV^{+} is positive net present value, NPV^{-} is negative net present value. The business is assumed profitable and feasible if the NetBCR ≥1 and it is considered not financially profitable and unreasonable when the NetBCR <1.

Internal rate of return

Internal rate of return (IRR) is the interest rate that makes the NPV value equal to zero. It can be estimated using the following formula (Lohmann and Baksh, 1993):

$$IRR = i' + \frac{NPV'}{NPV' - NPV''}(i'' - i') \quad (9)$$

where: NPV' is positive net present value, NPV" is negative net present value, i' is discount rate giving a positive NPV value, and i" is discount rate giving a negative NPV value. If IRR > interest rate, the business is considered profitable, and if IRR ≤ interest rate, the business is assumed not profitable.

Marketing channels

Marketing channels can be defined as the set of people, activities, and the intermediary organisations that play a crucial role in transferring the ownership of the products or distributing the products from producers to the end consumers. In this study, marketing channel was simply illustrated in flow diagram.

Marketing margin

Marketing margin is the difference between the price paid by the consumers and the price received by the fishermen. It can be stated in the percentage (Rahman et al., 2012):

$$\text{Marketing margin (\%)} = \frac{\text{Selling price} - \text{Purchase price}}{\text{Selling price}} \times 100 \quad (10)$$

It can also be expressed in the currency, calculated by mean of the following formula:

$$\text{Marketing margin (USD)} = \text{Selling price} - \text{Purchase price} \quad (11)$$

Fisher's share

The amount of Fisher's share was evaluated with the formula (Kaygisiz and Eken, 2018):

$$\text{Fisher's share (\%)} = \frac{\text{Price at the fisher}}{\text{Price at the retailer}} \times 100 \quad (12)$$

Marketing system was considered efficient if the value of fisher's share obtained was greater than 50 %, and it was said to be inefficient if fisher's share was less than 50 %.

Results

The research output of business analysis for the gillnet fishery of *S. commerson* and *S. guttatus* are presented in Table 1. About 88.92 tons of fresh fish and 158.04 tons of dried fish were collected from 18 fishing vessels across 216 fishing trips driven by KUB Kampung Baru. The selling prices of fresh fish and dried fish at the fishermen level were USD1 and 7 kg^{-1}, respectively. Comparatively, the annual revenue of dried fish (USD1,109,676) was 3.5 times higher than that of fresh fish (USD312,175). Additional income was also received from the selling of *S. guttatus* fresh fish as

Table 1. The summary of financial analysis of KUB Kampung Baru by types of products.

Parameters observed	*Scomberomorus commerson*		*Scomberomorus guttatus*	Total
	Fresh fish	Dried fish	Fresh fish	
Average annual fish production (ton)	88.92	158.04	80.29	
Price at the fishers (USD kg^{-1})	3.5	7.0	1.0	
Price at wholesaler (USD kg^{-1})	3.9	8.4	1.8	
Total revenue (USD $year^{-1}$)	312,175	1,109,676	84,565	1,506,416
Total revenue (USD $vessel^{-1} year^{-1}$)	26,015	92,473	14,094	132,582
Total profit (USD $year^{-1}$)	106,525	343,578	38,243	488,346
Total profit (USD $vessel^{-1} year^{-1}$)	8,877	28,631	6,374	43,882
R/C ratio	1.52	1.45	1.83	1.48*
Payback period (year)	0.87	0.54	0.73	0.63*
Break-even point in production (kg)	87,866	87,866	87,963	
Break-even point in price (USD)	3.4	3.9	1.1	
Net present value (USD)				1,417,004
Net benefit cost ratio				6.91
Internal rate of return (%)				159
Marketing margin (%)	9.09	16.67	40.00	
Marketing margin (USD)	0.4	1.4	0.7	
Fisher's share (%)	90.91	83.33	60.00	

Note: * R/C ratio and payback period were calculated on the basis of comprehensive values.

much of USD84,565 $year^{-1}$ or USD14,094 $vessel^{-1} year^{-1}$ (November–April). Thus, total profit obtained for all products was USD1,506,416 $year^{-1}$ or about USD132,582 $vessel^{-1} year^{-1}$.

Total investment cost required for the business was USD305,786. The highest operating-expense was depreciation cost of USD30,649, followed by maintenance cost of USD8,683 and fishing license of USD5,055 (Table 2). Total cost for the business was USD1,018,070 $year^{-1}$ consisted of USD44,387 for fixed cost and USD973,683 for variable costs (Table 3). The R/C ratios estimated for *S. commerson* fresh fish, *S. commerson* dried fish and *S. guttatus* fresh fish were 1.52, 1.45 and 1.83, respectively, indicating that the business was considered profitable. Currently, each owner of the ship received the monthly income about USD2,438 $trip^{-1}$ $vessel^{-1}$, which is far above the provincial minimum wage of USD172 $month^{-1}$.

In the present study, the payback period value obtained for the gillnet fishery business was 0.63 years (Table 1), showing that the invested capital can return after having 89 fishing trips within 7 months 15 days. The capital return includes in "fast" category (PP <3 years). The return on investment (ROI) value obtained was 160 %, meaning that every USD1.00 invested generates a profit of USD1.60. The BEP in production for all fish products ranged from 87,866–87,963 kg $year^{-1}$, which was less than total production of 327,250 kg $year^{-1}$, indicating that the current fishing business was considered profitable. The BEP in prices for *S. commerson* fresh fish and dried fish were USD3.4 and USD3.9, found slightly lower than the selling prices (USD3.5 and USD7), showing that the business was considered profitable. Meanwhile, the BEP in price for *S. guttatus* fresh fish (USD1.0) was slightly higher than the selling price (USD1.1), indicating that the business was thought unprofitable, suggesting the KUB should

Table 2. The investment and operational expenses for fishing business of KUB Kampung Baru.

Basic-financial (USD)	Fishing vessel	Machine	Accumulator	Gillnet for *Scomberomorus commerson*	Gillnet for *Scomberomorus guttatus*	Total
Investment	220,475	75,832	1,896	5,055	2,528	305,786
Depreciation cost	19,843	6,825	569	2,275	1,137	30,649
Maintenance cost	1,580	6,319	25	379	379	8,683
Fishing license	5,055					5,055
Total						350,173

Table 3. Descriptive annual fixed cost and variable cost spent by KUB Kampung Baru.

Fixed cost	Depreciation cost		Maintenance cost	Fishing license cost		Total
(USD $year^{-1}$)	30,649		8,683	5,055		44,387
Variable cost	Solar fuel	Salt	Ice	Crew's supplies	Crew's wage	Total
(USD $year^{-1}$)	59,149	90,998	10,616	54,599	758,320	973,683
Total cost						1,018,070

increase the current price to be at least USD1.2 or more. The expected NPV within a period of 5 years was USD1,417,004 with the values of net BCR and IRR were 6.91 and 159 %, respectively, indicating the gillnet fishery business for mackerel was considered feasible.

As shown in Figure 3, there were only two independent organisations involved in the marketing channel, i.e. KUB Kampung Baru acted for a producer and the wholesalers who delivered the fish products to the end consumers. The selling prices of *S. commerson* fresh fish and dried fish at the producer were USD1 and USD7 kg^{-1}. At the wholesalers or the end consumers, these products were priced at USD1.8 and USD8.4 kg^{-1}. Higher price in dried fish was due to additional cost for handling process (e.g. salt). Marketing margin and fisher's share for fresh fish were USD0.4 and 91 % and for dried fish were USD1.4 and 83 % (see Table 1), indicating the current marketing system was considered efficient. For comparative advantage, these values for dried fish compared to those predicted by Riani et al. (2013) were relatively high. Moreover, the selling price of *S. guttatus* fresh fish at the producer and the wholesalers were USD1.0 and USD1.8 kg^{-1}, respectively. Higher price at the wholesalers was attributable to additional cost for transportation charge. Marketing margin and fisher's share obtained were USD0.7 and 60 %, showing that the marketing system for *S. guttatus* fresh fish was also said to be efficient.

Fig. 3. (A-E) fish handling activity for *Scomberomorus commerson* in the form of fresh fish and the dried fish making. (F) the flowchart shows the marketing channel started from KUB Kampung Baru to the end consumers through the wholesalers.

Discussion

Based on business analysis and recognition from the fishing community in Muara Kintap Village, selling *S. commerson* dried fish is more profitable than selling fresh fish, which is priced about 7 times higher, indicating that the level of consumer acceptance or preference for dried fish is increasing. According to Riani et al. (2013), *S. commerson* dried fish from Muara Kintap is famous for its quality as compared to other places in South Kalimantan. This is because the catch is directly processed and dried on the ship, and is free from insects, caterpillars, flies and other destructive microorganisms. To improve product services, KUB is advised to create good branding and packaging so that their products can also be marketed directly to supermarkets with more competitive selling prices, apart from being sold through regular wholesalers. Like other food products, this product should also be registered with the MUI (Indonesian Ulema Council) and BPOM (the Food and Drug Monitoring Agency) to ensure that this food product is halal, high quality and safe for consumption.

Figure 4 presents the business model for the investigated area's gillnet mackerel fishery. This model undergoes a gap analysis encompassing stages of business activity, financial aspects, marketing channels, future scenarios, and potential remedies. The gillnet fishery business is started from (1) pre-production (preparation of fishing vessel, machine and license, fishing gear equipment, solar fuel, mapping and navigation, crew's supplies, and other operational expenses); (2) production (fishing activity at sea, fish and gear handling on board); (3) post-production (catch landed in fishing port, unloading catch from fishing vessels, and continued to fish handling/processing); and (4) proceeds to fish marketing (marketing channels, pricing, market destination, transportation and distribution to the end of consumers). Since fish is a highly perishable product, it should be properly handled. According to Lubis et al. (2019), a relatively long distribution channel will reduce fish quality by about 11 % seen from deterioration in the eyes, gills, body mucus, odours, and texture. The fisheries business activity is not a standalone endeavour. All stages of the fisheries business require continuous support from related agencies (banking, fisheries department, advertising agency, transportation service, water and air police). However, the limited access of fishermen to information technology or institutional channels creates a significant gap that needs to be addressed.

Financial analysis showed that the average R/C ratio obtained in the present study (1.48) was more or less equal to the drift gillnet fishery business (1.44) in Toboali of Bangka Belitung (Gerba et al., 2015) and the gillnet fishery business (1.50) in Barsela of Aceh (Rizal et al., 2017). The current payback period of the invested capital was about 0.67 years, which was considerably faster than payback period for gillnet fishery business (1.49 years) in Barsela of Aceh (Rizal et al., 2017) or drift gillnet fishery business (2–3 years) in Toboali of Bangka Belitung (Gerba et al., 2015), Cikidang Fishing Port of Pangandaran (Syauqi, 2019) and Nusantara Fishing Port of Sungailiat (Fitria et al., 2021). However, it was comparatively lower than payback period for gillnet fishery business (0.14 years) from Jatigede of Sumedang (Setiawan et al., 2018) or gillnet fishery business (0.43 years) from Sangatta of East Kalimantan (Helminuddin et al., 2020). Variation in

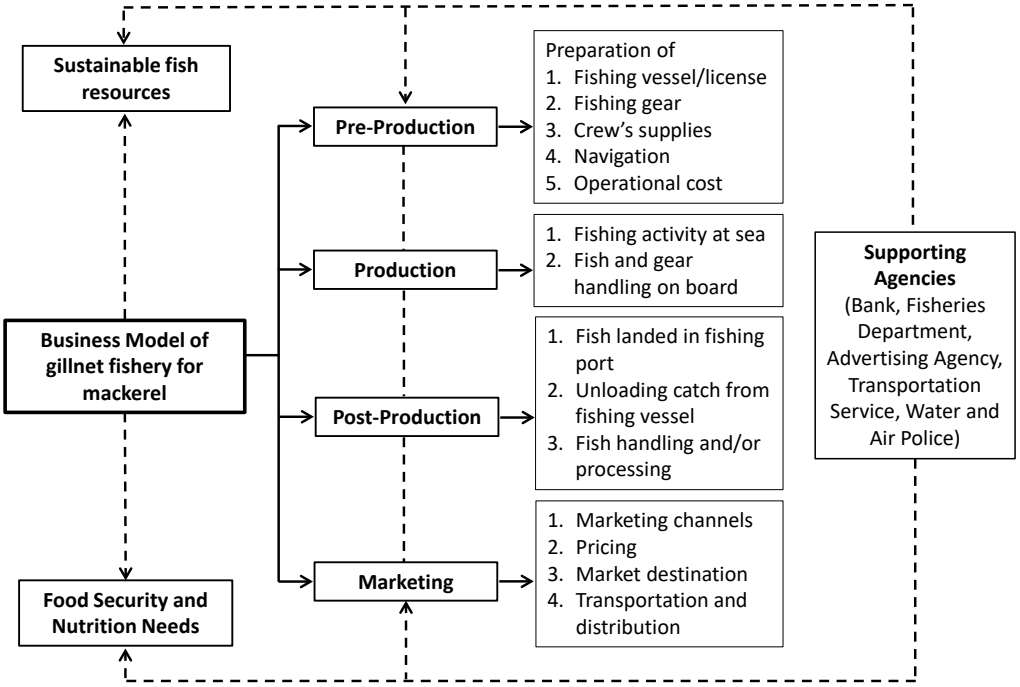

Fig. 4. The business model of gillnet fishery for mackerel of KUB Kampung Baru in Tanah Laut District, South Kalimantan, Indonesia.

payback period may be attributed to the type of fishing gears, fishing trip, fish production, operational cost, and market price. It implied that investment with shorter payback period was considered to have lower risk (Lohmann and Baksh, 1993; Lin, 2010). In other words, the shorter the payback period the more viable the business (Kim et al., 2013). Favourable payback period and high return on investment (ROI) make this investment highly attractive. The short payback period indicates a swift return of capital, while the high ROI signifies the potential for significant profit generation in a relatively short timeframe. A short payback period might seem attractive, but it's crucial to consider the long-term impact of inflation and asset depreciation on the investment's value (Albu and Albu 2003; Zamfir et al., 2016). The BEP in price for *S. commerson* fresh fish was considered profitable, but not for *S. guttatus* fresh fish because of the lower selling price. On the basis of comparative advantage, the BEP value for *S. commerson* dried fish was considerably higher than reported by Riani et al. (2013) due to differences in product quantity. Likewise, the BEP value for *S. guttatus* fresh fish was relatively higher compared to the BEP value studied by Setiawan et al. (2018) where the selling price of marine fish in the market is higher than freshwater fish.

Based on the investment criteria, it was found that the expected NPV within a period of 5 years was greater than zero, the net BCR was greater than one and the IRR value was greater than interest rate of 5 %, clearly showed that the gillnet fishery business was considered feasible. On the basis of the gillnet fishery business, the NPV >0 was also investigated in other geographical areas such as in Nusantara Fishing Port (PPN) Sungailiat of Bangka District (Fitria et al., 2021), Sangatta District of East Kalimantan Province (Helminuddin et al., 2020), Barsela of Aceh Province (Rizal et al., 2017), and Cituis Fishing Port of Tangerang District (Juliani et al., 2019). Variation in the NPV was attributable to the benefit cash flows, operational cost, investment periods, applicable interest rates, and business scale, among others. The net BCR of 6.91 in the present study was comparatively higher than the previous studies (Rizal et al., 2017; Helminuddin et al., 2020; Fitria et al., 2021) with the values varied between 1.33 and 3.37. The IRR value obtained was also relatively higher than that reported by Helminuddin et al. (2020) and Rizal et al. (2017), but it was lower than studied by Juliani et al. (2019). The higher the IRR value, the more feasible the investment. A marked difference in the IRR value was attributable to variation in the NPV gained, the length of time for an investment, and applicable discount rates in the relevant year (Lohmann and Baksh, 1993; Pio et al., 2016).

Although the gillnet fishery business of the KUB Kampung Baru is considered feasible and profitable; it still faces several problems internally both in terms of financial management capabilities, quality of human resources, mastery of information technology, fishermen's bargaining value in determining prices and the difficulty of meeting large market demands related to natural factors including sea weather and fishing season. Such financial and technical problems are also reported in the previous studies (Mualli et al., 2014; Rizal et al., 2017; Helminuddin et al., 2020; Fitria et al., 2021). This must be a special concern for all parties to overcome these problems. In their pursuit of improving gillnet efficiency and productivity, researchers have actively explored technological advances. These efforts include modifications to

webbing materials and mesh size selectivity for better catches (Rengi et al., 2021; Tupamahu et al., 2023), alongside the implementation of GPS and fish finder technology for enhanced targeting and navigation (Natsir et al., 2020).

Unlike the multi-layered marketing channels observed in Banjarmasin Fishing Port (Rahman et al., 2019), Muara Kintap Village relies on a simpler system with just two key players i.e. KUB Kampung Baru acts as producer and the wholesalers who deliver the fish to the end consumers. This streamlined approach eliminates transportation costs and risks associated with unreliable buyers, thanks to a strong, pre-existing relationship with their chosen wholesalers. As Kwon and Suh (2004) suggest, a reputation-based partnership fostered by good communication builds trust among key players, leading to a sustainable business model. This trust also facilitates easier access to financing from local banks for the KUB Kampung Baru.

The success of today's fishing business is significantly enhanced by digital information technology. A prime example is the "Nelayan Pintar" (Smart Fisher) system, an Android-based application launched in August 2015. This user-friendly system equips fishermen with easy access to critical information like fishing grounds, oceanographic conditions, fishing port locations, fish prices, and fuel estimations. A field survey by Muawanah et al. (2017) across 27 Indonesian fishing ports found that 71.19 % of the 582 respondents used the Nelayan Pintar app, with a high satisfaction rate of 84.10 % regarding their catches. This data highlights the positive impact of digital tools like Nelayan Pintar on the success of the fishing industry.

Data analysis suggests the mackerel fishery in Tanah Laut District, South Kalimantan Province, is currently underexploited (Table 4). The average number of fishing trips (6,788) remains below the open access (OA) baseline of 6,818 trips. This indicates that existing management strategies are effectively preventing economic overfishing by keeping fishing activity within sustainable levels. To ensure the long-term viability of the data-poor mackerel fishery, a two-pronged approach is recommended. First, mapping coastal suitability based on biophysical utilisation parameters, such as sea surface temperature and chlorophyll-a concentration, is crucial. Nugraha et al. (2019) found a strong positive correlation (92.6 %) between these parameters and catch per unit effort (CPUE) of mackerel. This information can be used to identify areas with higher potential fish stocks. Second, implementing catch-based data collection methods is essential for improved fishery management. By gathering more accurate data on catch rates and distribution, researchers and policymakers can develop more informed strategies for sustainable fishing practices.

Optimising the post-harvest infrastructure is crucial to ensure the long-term sustainability of the mackerel fishery in Muara Kintap. Given the highly perishable nature of fish, improvements to sanitation and hygiene facilities at the Muara Kintap Fishing Port's auction area are essential. Additionally, revisiting price control legislation, as suggested by Syarwani et al. (2016), could benefit both fishers and consumers. This fishery demonstrably contributes to the positive social and economic well-being of the community. Studies by Le Floc et al. (2011) highlight the attractiveness of investment in the gillnet fishery business, citing profitability and stability within the fisheries sector. However, addressing the financial and technical challenges faced by KUB Kampung Baru, as identified in this research, remains paramount. Ultimately, a well-managed fishery not only promotes sustainable fish resources but also contributes positively to the food security and nutritional needs of the community.

Despite its focused scope, this business model gap analysis aligns with national trends identified by Sulistijowati et al. (2023) who employed the importance-performance analysis (IPA) method to investigate the dynamics of the Indonesian marine and fisheries sector. The challenges identified here resonate with those empirically documented in other gillnet fishery studies (Rahayu et al., 2019; Helminuddin et al., 2020; Lamsah et al., 2024), suggesting broader systemic issues within the industry.

Table 4. Annual fish production of *S. commerson* by districts in South Kalimantan Province, Indonesia from 2014–2020.

Districts	Fish production (tons)						
	2014	2015	2016	2017	2018	2019	2020
Tanah Laut	1,599.60	1,807.68	2,151.48	2,420.00	2,424.00	261,191	546,236
Tanah Bumbu	955.68	789.47	957.90	2,117.00	2,121.00	9,477,403	3,397,960
Banjarmasin	72.00	69.80	89.10	157.00	252.50	-	-
Kotabaru	3,923.23	4,378.61	4,405.20	3,886.00	3,890.00	2,574,889	4,229,025
Total	6,550.51	7,045.56	7,603.68	8,580.00	8,687.50	12,313,483	8,173,221

Source: Department of Marine and Fisheries, South Kalimantan Province (2021).

Conclusion

The gillnet fishery business for mackerels shows promise due to profitability, efficiency, and fast returns. However, despite its potential, it remains underexploited. Therefore, precautionary measures are crucial to ensure its sustainability.

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Author contributions: Ahmadi: Designed the study, data analysis, and manuscript writing.

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Supplementary Table 1. Questionnaire: The gillnet fishery business of KUB Kampung Baru.

Date of Survey : Time : ☐ 6 – 12 am.
☐ 1 – 6 pm.

A. IDENTITY OF RESPONDENT

Name : ……....

Home Address: ……

Sex : ☐ M ☐ F

Age : ……. year old

Dependent Family Member: ☐ 1-2 ☐ 3-4 ☐ 5-6 ☐ > 6

Education level : ☐ Elementary School ☐ Junior High School ☐ Senior High School
☐ Bachelor Degree ☐ Master Degree ☐ Doctor Degree

Membership : ☐ Leader ☐ Secretary ☐ Treasurer
☐ Advisor ☐ Supervisor ☐ Ship Crew

B. FISHING ASPECT

Member of KUB : …….. persons Year of establishment = ……

Fishing vessel : Number = …… units. Size = ……. GT

Fishing gear : Gillnet for *Tenggiri* = …… units. Gillnet for *Kembung* = …… units
Net length = …….. m Mesh depth = …… m
Net material = ☐ Monofilament ☐ Multifilament
Mesh sizes = …….. inch (*Tenggiri*), and …….. inch (*Kembung*)

Fishing ground : ☐ Muara Baru waters ☐ Outside : ……..

Fishing operation : Duration of Setting and Hauling = ……. h.
Duration of Drifting process = ……. h.
Time : …….. am/pm.

Fish Production : …… $kg^{-1}.trip^{-1}.vessel^{-1}$

Main target of fish species = ……....

Others = ……..……..

Grand aids received : ……...…….……...

Problem being faced : ……..

……...

……...

C. FINANCIAL ASPECT

Table 1. The financial aspect of KUB Kampung Baru

Parameters observed	*Tenggiri*		*Kembung*	Total
	Fresh fish	Dried fish	Fresh fish	
Average annual fish production (ton)				
Price at the fishers (USD.kg^{-1})				
Price at wholesaler (USD.kg^{-1})				
Total revenue (USD.year^{-1})				
Total revenue (USD.trip^{-1})				
Total Profit (USD.year^{-1})				
Total Profit (USD.trip^{-1})				

Table 2. Investment and operational expenses for fishing business of KUB Kampung Baru (in USD)

Basic-Financial	Fishing vessel	Machine	Accumulator	Gillnet		Total
				Tenggiri	*Kembung*	
Investment						
Depreciation cost						
Maintenance cost						
Fishing license						
Total						

Table 3. Annual fixed cost and variable cost spent by KUB Kampung Baru (in USD)

Fixed cost	Depreciation	Maintenance	Fishing license	Total
Variable cost	Solar fuel	Salt	Ice	Crew's supplies	Crew's wage	Total
Total cost						

Problem being faced : ……...

……..…….

D. MARKETING ASPECT

Marketing channel : ☐ direct ☐ indirect (through the intermediateris)

Distribution of fish production : ☐ Local ☐ Regional ☐ National ☐ International

Number of wholesaler(s) : ..... person(s) come from : ☐ Muara Baru ☐ Outside

Number of Retailer(s) : ..... person(s) come from : ☐ Muara Baru ☐ Outside

Payment method : ☐ cash ☐ credit ☐ other

Problem being faced : ……

……

……