Fisheries Journal, 15 (6), 3323-3339 (2025)
http://doi.org/10.29303/jp.v15i6.1927

SMALL-SCALE CAPTURE FISHERIES MANAGEMENT STRATEGY (ARTISANAL FISHERIES) IN TEGAL REGENCY WATERS

Strategi Pengelolaan Perikanan Tangkap Skala Kecil (Artisanal Fisheries) di Perairan Kabupaten Tegal

Dwi Purwanto[1*], Etty Riani[2], Hedi Heryadi[3]

[1]Postgraduate Program in Marine Science, Terbuka University, [2]Department of Fisheries Resource Management, Bogor Agricultural University, [3]Agribusiness Study Program, Terbuka University

Postgraduate School Terbuka University (SPs-UT) Pondok Cabe, South Tangerang

[*]Corresponding author: dwisupm@gmail.com

(Received October 27th 2025; Accepted December 28th 2025)

ABSTRACT

Small-scale capture fisheries play a crucial role in coastal community livelihoods but face challenges of overexploitation and low competitiveness. This study aimed to analyze the characteristics and socio-economic conditions of small-scale capture fisheries and develop sustainable management strategies in Tegal Regency. The study was descriptively and conducted in August 2023 using surveys and interviews with 60 fishers and stakeholders. Data were analyzed using the SWOT (*Strengths, Weaknesses, Opportunities, Threats*) method. The main fishing gears were gemplo, badong, trammel net, handline, payang, and arad net, with the highest productivity (0.59 tons/trip) from gemplo. Most fishers graduated from elementary school (91.67 %) and earned moderate incomes (Rp 2.19–4.23 million). SWOT analysis showed an aggressive strategy position (Quadrant I), prioritizing port optimization for training and insurance programs, value-added development through export and cold storage, and institutional strengthening via HNSI and KUB.

Keywords: Artisanal Fisheries, Management Strategy, SWOT, Tegal

ABSTRAK

Perikanan tangkap skala kecil berperan penting dalam ketahanan pangan dan ekonomi masyarakat pesisir, namun menghadapi tantangan berupa eksploitasi berlebih dan rendahnya daya saing nelayan. Penelitian ini bertujuan untuk menganalisis karakteristik perikanan tangkap skala kecil, kondisi sosial ekonomi nelayan, serta menyusun strategi pengelolaan berkelanjutan di Kabupaten Tegal. Penelitian dilakukan pada Agustus 2023 dengan metode survei dan wawancara terhadap 60 nelayan dan pemangku kepentingan terkait. Analisis data secara deskriptif dan menggunakan pendekatan SWOT (*Strengths, Weaknesses, Opportunities, Threats*). Hasil penelitian menunjukkan bahwa alat tangkap utama meliputi gemplo, badong, trammel net, pancing, payang, dan arad dengan produktivitas tertinggi pada alat tangkap gemplo (0,59 ton/trip). Mayoritas nelayan berpendidikan SD (91,67 %) dan berpendapatan Rp

2,19–4,23 juta/bulan. Analisis SWOT menunjukkan posisi strategi pada kuadran I (agresif), sehingga strategi prioritas meliputi optimalisasi pelabuhan dan TPI untuk pelatihan dan asuransi nelayan, peningkatan nilai tambah hasil tangkapan melalui ekspor dan cold storage, serta penguatan kelembagaan HNSI dan KUB.

Kata Kunci: Artisanal Fisheries, Strategi Pengelolaan, SWOT, Tegal

INTRODUCTION

Small-scale capture fisheries (artisanal fisheries) are the backbone of fisheries activities in Indonesia. More than 85% of the fishing fleet is classified as small-scale, characterized by the use of simple fishing gear and an operating range of less than four nautical miles (Vatria *et al*, 2019; Mardyani *et al.*, 2019). However, this sector faces various challenges, such as overfishing. This condition also occurs in Tegal Regency, Central Java Province. Based on data from the Tegal Regency Maritime Affairs and Fisheries Service (2021), there are 811 fishing households (RTP) with more than 2,000 fishermen, most of whom operate using vessels measuring 5–10 GT and traditional fishing gear such as gemplo, arad, badong, payang, trammel nets, and fishing lines.

The high intensity of fishing, the use of environmentally unfriendly fishing gear, and weak supervision have put pressure on fish resources in Tegal waters. Horizontal conflicts between fishermen often arise due to overlapping fishing grounds. This condition shows that the small-scale capture fisheries management system in Tegal Regency has not been running optimally, so a comprehensive management strategy is needed to realize sustainable and equitable fisheries.

Various previous studies have highlighted the importance of ecological, social, and economic management strategies. Sudarmo *et al.,* (2016) identified the need to apply a SWOT analysis to improve fisherman institutions. Simanjuntak *et al.,* (2024) added that bioeconomic-based management needs to consider the balance between maximum sustainable yield and maximum economic yield.

The Ecosystem-Based Fisheries Management (EBFM) approach is considered effective in integrating ecological, social, and economic aspects in fisheries resource management (Gullestad *et al.*, 2017; Karim *et al.,* 2020). Furthermore, the application of the SWOT (Strengths, Weaknesses, Opportunities, Threats) analysis method has been shown to assist in identifying priority strategies for small-scale fisheries management (Adiyanto *et al.,* 2022). Based on the theory and research results, an adaptive and participatory small-scale capture fisheries management strategy is expected to increase the efficiency of resource utilization, strengthen institutions, and improve the socio-economic conditions of fishermen. The objectives of this study are to analyze the characteristics of small-scale capture fisheries in Tegal Regency, assess the socio-economic conditions of fishermen, and develop alternative strategies for small-scale capture fisheries management in Tegal Regency waters based on a SWOT analysis.

METHODS

This research was conducted in the coastal areas of Tegal Regency (TPI Larangan and TPI Suradadi) in August 2025. This descriptive study aimed to provide a comprehensive overview of the condition of small-scale capture fisheries in Tegal Regency, from ecological, socioeconomic, and institutional perspectives (Creswell & Poth, 2023; Sugiyono, 2023).

The descriptive approach was used to describe the phenomena occurring in the field factually and systematically without treating the variables under study (Yin, 2023). The analytical approach was used to identify internal and external factors influencing small-scale

capture fisheries management and to develop alternative sustainable management strategies through a SWOT analysis (Saaty, 2022; Adiyanto *et al.,* 2022).

The data used consisted of primary and secondary data. Primary data was obtained through field surveys and in-depth semi-structured interviews with 60 individuals, including fishermen, fishermen group administrators, coastal community leaders, the Tegal Regency Marine Affairs and Fisheries Service, PSDKP (National Marine Resources Conservation Agency), extension workers, and academics. Secondary data was obtained from government agencies and related institutions such as the Tegal Regency DKPP (East Java Fisheries and Fisheries Agency), BPS (Statistics Indonesia), as well as previous research and scientific publications.

Data collection was conducted through direct observation, in-depth interviews, questionnaires, and documentation. Data analysis was conducted using descriptive analysis and SWOT analysis. Descriptive analysis was used to describe the socioeconomic characteristics of fishers and the institutional conditions of fisheries. SWOT analysis was used to identify internal and external factors, assign weightings to IFAS–EFAS, and develop alternative strategies for small-scale capture fisheries management in Tegal Regency waters (Bryhn *et al.,* 2021).

RESULT

General Conditions of the Research Location

Tegal Regency is a region in Central Java Province, with Slawi as its capital. Its territory comprises 878.7 km² of land and 121.5 km² of water, located at coordinates 108°57'6"–109°21'30" East Longitude and 6°50'41"–7°15'30" South Latitude (Bappeda and Litbang Tegal Regency, 2023). Tegal Regency has a coastline of approximately 30 km from Kramat District to Warureja. The number of active fishermen in 2023 was 2,533, with 1,931 holding Fisheries Business Cards (KUSUKA) as of December 2023. The number of fishing fleets by type operating in Tegal Regency waters is presented in Figure 1.

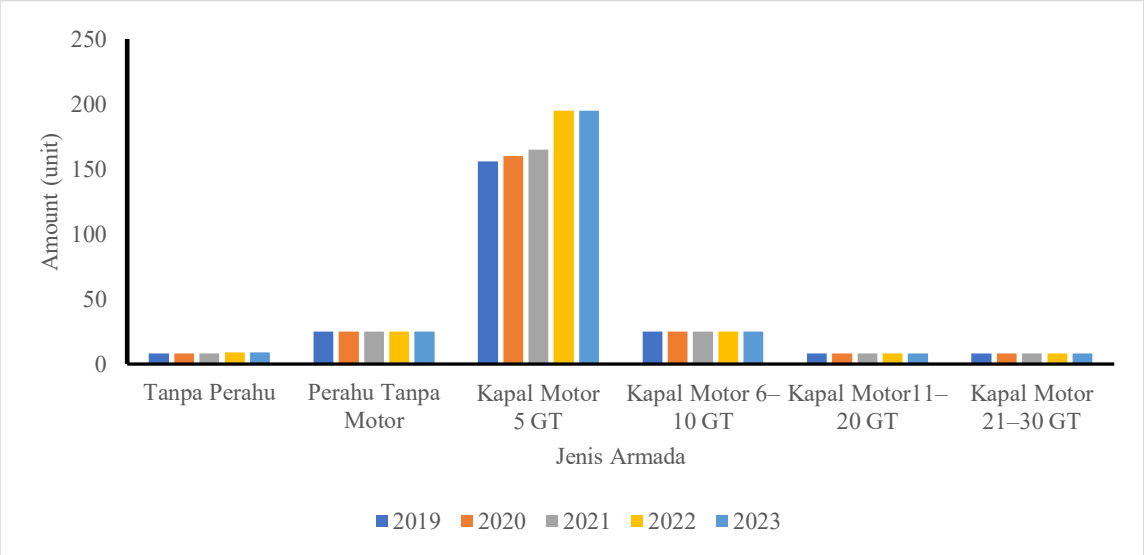

Figure 1. Number of Fishing Vessels by Type

The fishing fleet in Tegal Regency is dominated by small-scale fishermen (artisanal fisheries). According to Law No. 45 of 2009 concerning Fisheries, small-scale fishing vessels are defined as vessels measuring <5 GT. The number of fishing vessels <5 GT in Tegal Regency from 2019 to 2021 was 165. This number increased to 195 in 2022.

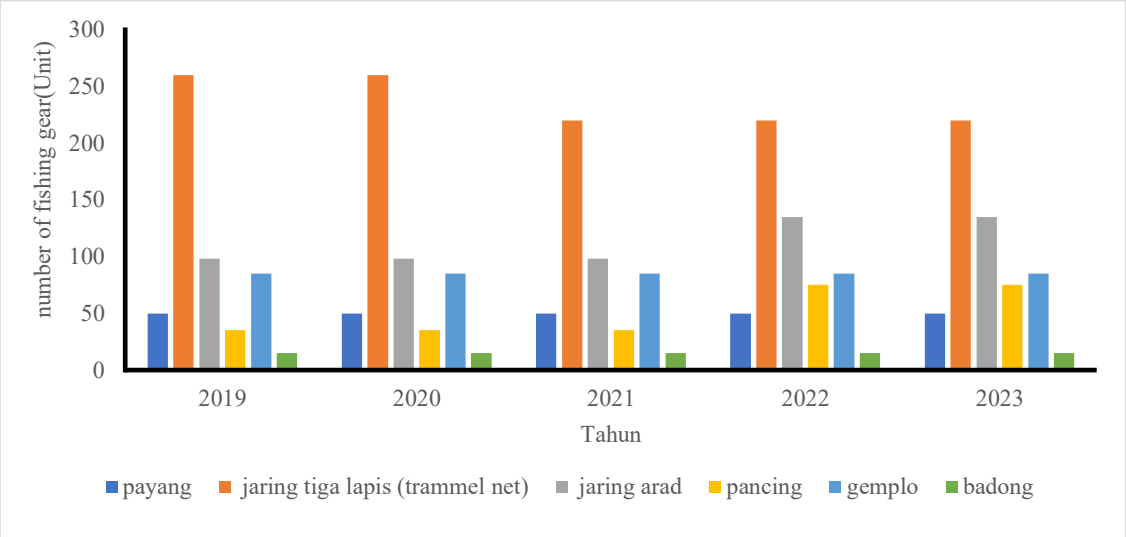

Figure 2. Number of Fishing Gear with Vessels < 5 GT

Based on Figure 2, small-scale fishers in Tegal use several types of fishing gear, namely payang, trammel nets, arad nets, fishing lines, gemplo, and badong. The number of small-scale fishing fleets remained stable from 2019 to 2023, with an increase in 2022. The increase occurred in arad nets, from 98 to 135 units, and fishing lines, from 35 to 75 units.

Fishing Gear Production and Productivity

The main catches landed by fishermen using small-scale fishing fleets are anchovies (*Stolephorus* sp.) (from gemplo), swimming crabs (Badong), banana prawns (Trammel nets), mackerel (Scomberomorus commerson) (from fishing lines), tuna (Auxis thazard) (payang), and rebon shrimp (Belacan shrimp) (Arad nets). The production development for each species is presented in Figure 3.

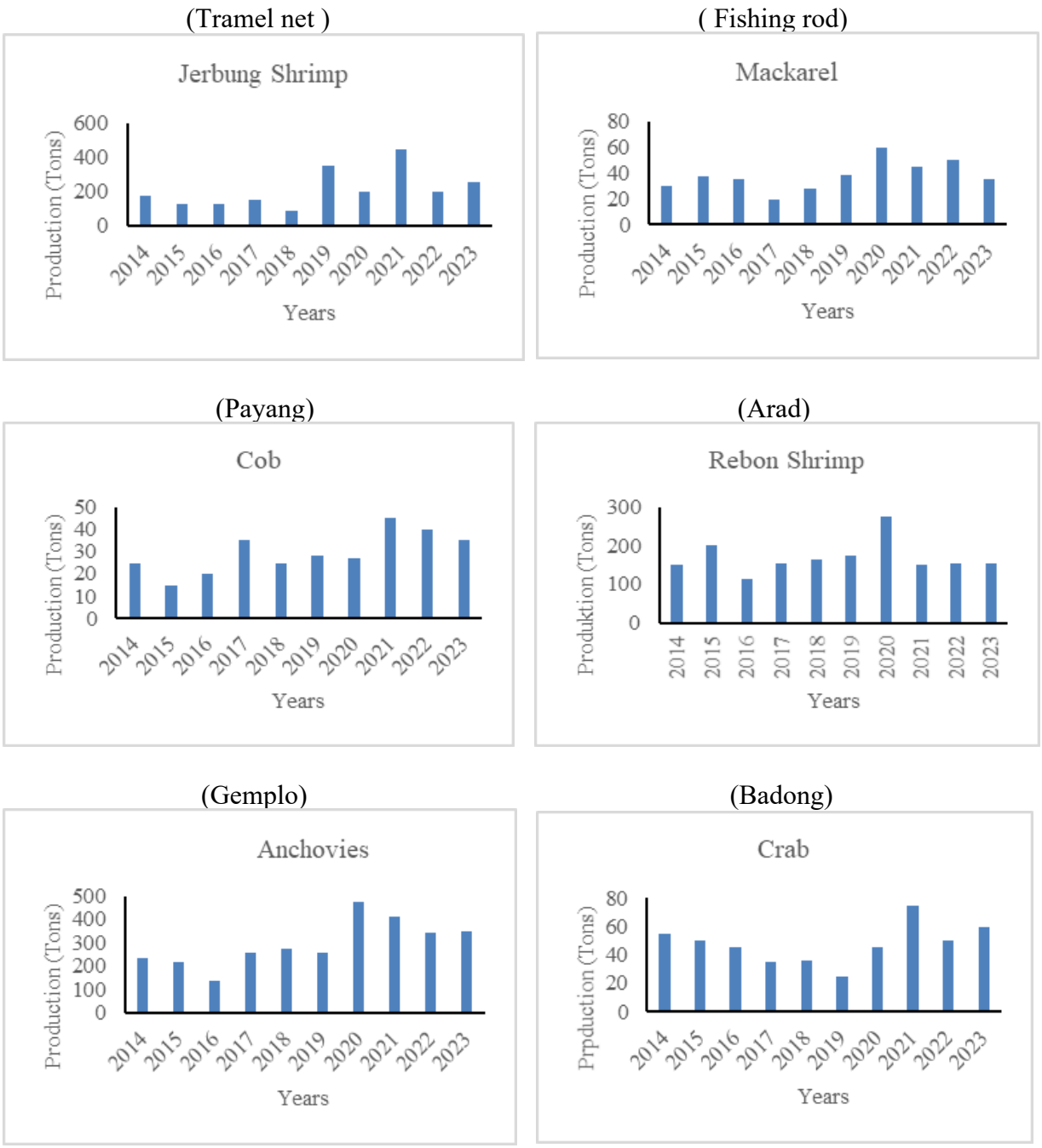

Figure 3. Development of Production of Main Catch Results of Small-Scale Fishing Fleets in Tegal Waters

Based on Figure 3, anchovy production in Tegal waters peaked in 2020 at 475 tons, with the lowest in 2016 at 135 tons. Crab production peaked in 2021 at 75 tons, with the lowest in 2019 at 25 tons. Mackerel production peaked in 2020 at 60 tons, with the lowest in 2017 at 20 tons. Skipjack tuna production peaked in 2021 at 45 tons, with the lowest in 2015 at 15 tons. Meanwhile, rebon shrimp (Acetes indicus) had the highest production in 2020 at 275 tons, with the lowest in 2016 at 115 tons. The catch composition for each fishing gear is presented in Table 1.

Table 1. Catch Composition

Composition of Catch	Fishing Gear					
	Gemplo	**Badong**	***Trammel net***	**Pancing**	**Payang**	**Arad**
White pomfret/ *White pomfret*					√	
Indian mackerel/ *Indian mackerel*	√		√			
Red snapper / *Lutjanus campechanus*				√		
Grouper / *Epinephelus sap.*				√		
Banyar / *Siganus canaliculatus*			√			
Swimming crab/ Swimming crab		√				√
Banana prawn/ *Banana prawn*			√			√
Velvet shrimp/ *Velvet shrimp*			√			√
Belacan shrimp/ *Belacan shrimp*						√
Anchovy/ *Anchovy*	√					
Pennahia argentata/ *Pennahia argentata*						√
Squid / *Loligo* sp.					√	√
Skipjack tuna / *Auxis thazard*					√	
Spanish mackerel / *Scomberomorus*				√	√	
Crab / *Scylla serrata*		√				
Eleutheronema tetradactylum/ *Eleutheronema tetradactylum*			√		√	
Johnius belangerii/ *Johnius belangerii*			√			
Selar / *Selar crumenophthalmus*			√			

Sources: Research 2025

Based on Table 1, fishermen's catches in Tegal Regency waters are significantly influenced by the type of fishing gear used. Badong fishing gear primarily catches blue swimming crabs, while gemplo is used for small pelagic fish such as mackerel and anchovies. Trammel nets are semi-selective, catching a variety of shrimp species. Lines are more selective and target high-value fish such as snapper, grouper, and mackerel. Meanwhile, arad nets produce a diverse catch of shrimp, grouper, and blue swimming crabs, but are non-selective and pose a risk of damaging seabed habitats, despite their high productivity. The results of the fishing gear productivity calculations are presented in Figure 4.

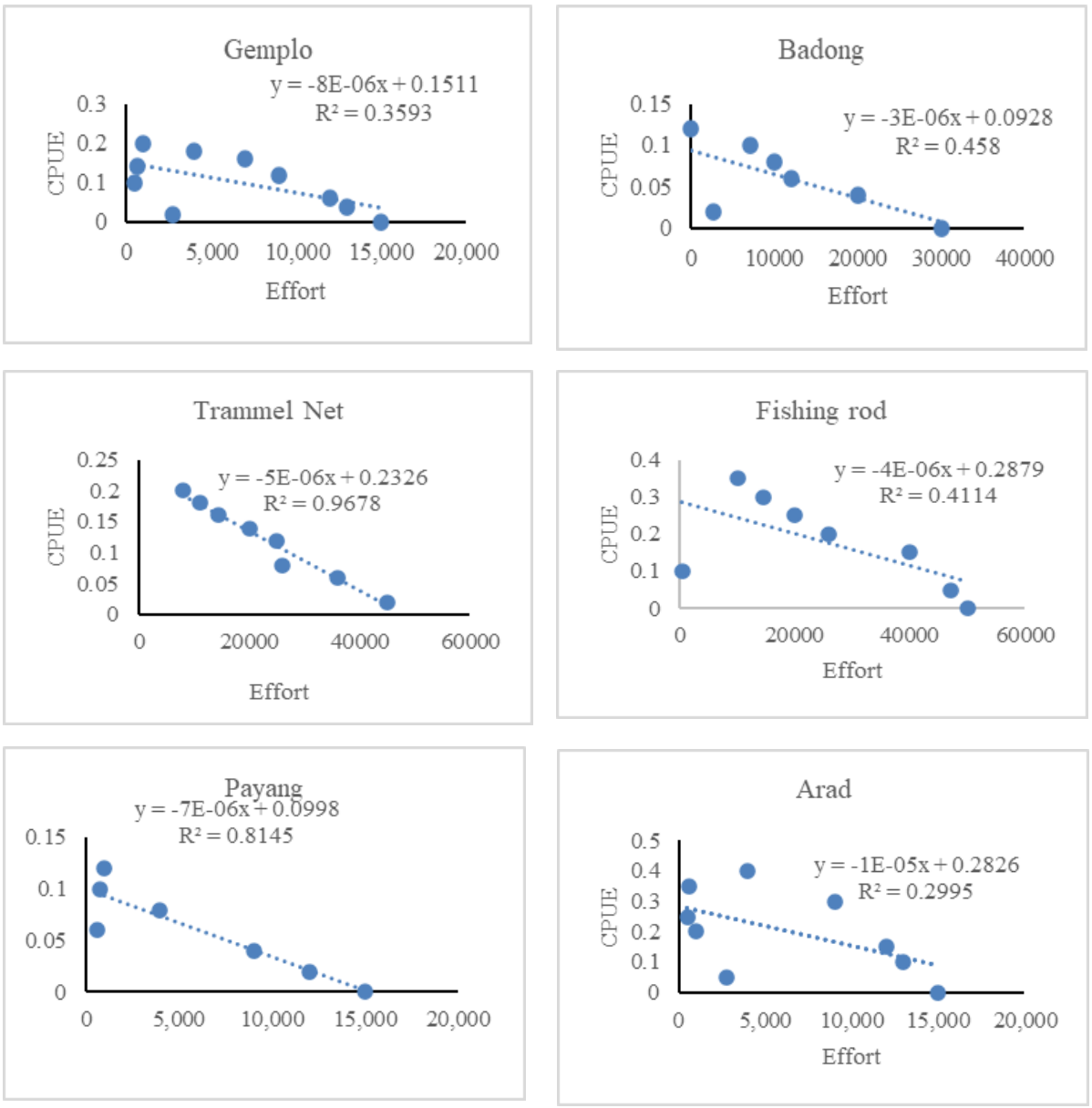

Figure 4. Catch Per Unit Effort

According to Figure 4, the relationship between Catch Per Unit Effort (CPUE) and fishing effort for six types of fishing gear—gemplo, badong, trammel net, fishing line, payang, and arad—shows a negative trend. This means that as fishing effort increases, the catch per unit effort tends to decrease. The R^2 values range from 0.29 to 0.97, with trammel nets having the strongest relationship (R^2 = 0.9678), while payang and arad are weaker. This decline in CPUE indicates high fishing pressure on fish stocks. According to the FAO (2022), this trend indicates potential overfishing, particularly for trammel nets and fishing lines, which exhibit a strong relationship between CPUE and effort.

Socioeconomic Profile of Fishermen

The demographics of respondents can be seen from their education level in Table 2

Table 2. Distribution of Education Levels

Education	Frequency	Persentage (%)
No Schooling	0	0,00
Elementary School	55	91,67
Middle School	3	5,00
High School/Vocational School	2	3,33
University	0	0,00
Total	60	100

Sources: Research 2025

The age distribution of respondents in the study ranged from 46 to 55 years, representing 50% (Table 3). The oldest respondent was 65 years old, while the youngest was 26 years old.

Table 3. Age Distribution of Respondents

Age Inteval (Year)	Frequency	Persentage (%)
25-35	3	5,00
36-45	18	30,0
46-55	30	50,0
56-65	8	13,3
66-75	1	1,67
Total	60	100 %

Sources: 2025 Research

Based on Tables 3 and 4, most fishermen in Tegal Regency have low education, with 91.67% only elementary school graduates. Most are aged 46–55 years (50%). The income of the majority of fishermen is classified as moderate, namely between Rp2,191,161–Rp4,236,000 or more than 80% of the total fishermen. Fishermen with high incomes come from users of fishing gear arad (7.5%), payang (7.6%), fishing rods (9.8%), trammel nets (6.9%), badong (6.7%), and gemplo (6.7%). The income level of fishermen can be seen in Figure 5.

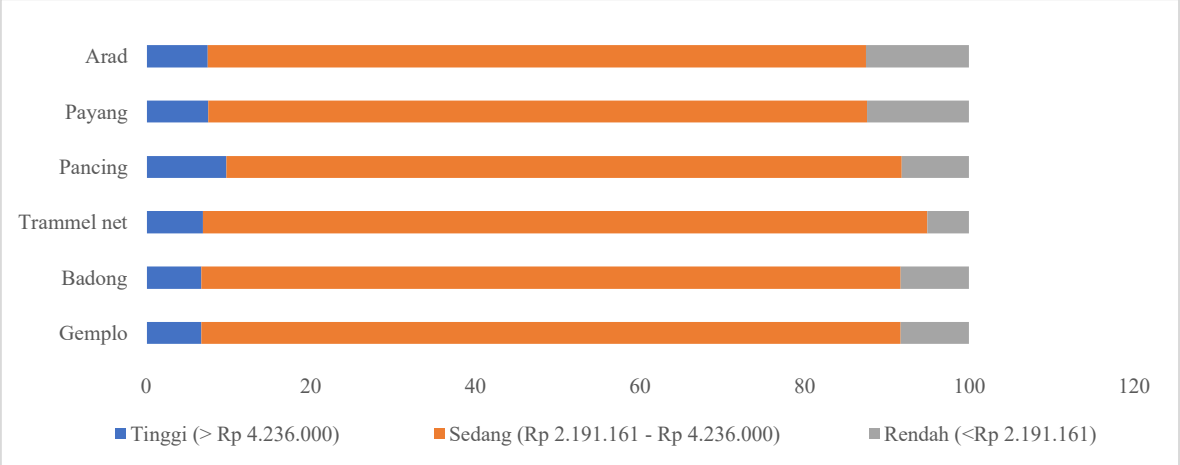

Figure 5. Fishermen's Income Level
Source: 2025 Research

Institutional Analysis

Fisheries management in Tegal Regency involves two institutional aspects: structural and cultural. The structural aspect includes government institutions such as the Tegal Regency Fisheries Office, the Regional Development Planning Agency (BAPPEDA), the Research and Development Agency (LITBANG), and the Marine and Fisheries Resources Monitoring Work Unit (PSDKP). The Fisheries Office plays a primary role in formulating, implementing, and evaluating fisheries policies. BAPPEDA and LITBANG coordinate regional development planning covering the fisheries sector. PSDKP is responsible for supervising and enforcing law enforcement on marine and fisheries activities.

Culturally, there are community organizations such as the Indonesian Fishermen's Association (HNSI), which serves as a forum for advocacy and capacity building for fishermen. The Tegal Branch of HNSI plays a role in promoting fisheries modernization, improving fishermen's welfare, and fighting for legal protection for fishermen.

Joint Business Groups (KUB) are a form of fishermen's organization aimed at improving businesses and welfare through economic cooperation. There are 15 KUBs in Tegal Regency, each with a minimum of 25 fishermen. The KUB was formed through member deliberations and accompanied by fisheries extension workers and facilitated by the Fisheries Service.

SWOT Analysis of Small-Scale Capture Fisheries Management

The analysis used to determine the management strategy for small-scale capture fisheries in Tegal Regency was conducted using a SWOT analysis. A SWOT analysis is a strategic planning method that evaluates the strengths, weaknesses, opportunities, and threats of a business's operations in general. Based on interviews with respondents, the internal factors (strengths and weaknesses) are presented in Table 4.

Table 4. Results of Identification of Internal Factors (Strengths and Weaknesses)

No.	Field	Strengths	Weakness
1	Fisheries Infrastructure	• Availability of active fishing ports (PPP Larangan and Suradadi)	• Inadequate port facilities (cold storage, damaged facilities)
2	Human and Social Resources	• Availability of TPI (traditional fisheries processing facilities) and catch auction facilities	• Lack of CBIB/PIT outreach and technical training
3	Marine and Environmental Affairs	• Traditions and experience of local fishermen	• Suboptimal management of ship waste, estuary ecosystems, and port cleanliness
4	Institutional and Financing		• Lack of access to capital and active cooperatives (weak KUB/KUD)

Sources: 2025 Research

The results of the identification of external factors (Opportunities and Threats) for small-scale capture fisheries management are presented in Table 5.

Table 5. Results of the Identification of External Factors (Opportunities and Threats)

No.	Field	Opportunites	Threats
1	Government Policy & Support	• Existing government programs (Fishermen's Insurance, Special Allocation Funds (DAK), Training Programs)	• Fishermen do not yet understand the PIT policy
2	Markets and the Economy	• Potential domestic and export markets for seafood (crab, shrimp, fresh fish)	• Dependence on middlemen and an unfair distribution system
3	Community Empowerment, Environment, and Climate	• Consumer preferences	• Climate change and extreme weather (hindering fishermen from going to sea)

Sources: 2025 Research

The next step is to compile the Internal Factor Evaluation (IFE) and External Factor Evaluation (EFE) analysis matrices based on the questionnaire distributed to respondents. The results of the IFE and EFE analysis matrices are presented in Tables 6 and 7.

Table 6. Internal Factor Evaluation (IFE) analysis matrix

No.	***Strengths***	Weight	***Rating***	Score
1	Availability of active fishing ports (PPP Larangan and Suradadi)	0,136	4	0,544
2	Availability of TPI and catch auction facilities	0.107	4	0,428
3	Traditions and experiences of local fishermen	0.120	3	0,360
4	Tegal sea potential for catch production (pelagic fish, demersal fish, crab)	0.130	4	0,520
	Subtotal	**0,493**		**1,852**
	Weaknesses			
5	Lack of access to capital and institutional capacity among fishermen (KUB/KUD are inactive).	0.128	2	0,256
6	Lack of CBIB/PIT outreach and technical training.	0.107	2	0,214
7	Inadequate port facilities (cold storage, damaged facilities).	0.132	2	0,264
8	Suboptimal ship waste management and port cleanliness.	0.140	2	0,280
	Subtotal	**0,507**		**1,014**
	Total	**1,000**		**2,866**

Sources: 2025 Research

Table 7. External Factor Evaluation (EFE) analysis matrix

No.	***Opportunities***	Weight	***Rating***	Score
9	Support from government programs (Fishermen's Insurance, Training Programs, Special Allocation Funds, etc.)	0.137	4	0,548
10	Potential domestic and export markets for marine products (crab, fresh fish)	0.120	4	0,480
11	HNSI's active role in advocating for fishermen	0.107	3	0,321
12	Consumer preferences	0,106	4	0,424
	Subtotal	**0,470**		**1,733**
	Threats			
13	Climate change and extreme weather	0.133	2	0,266
14	Fishermen do not fully understand the PIT policy	0.120	2	0,240
15	Abrasion and sedimentation in harbor estuaries	0.110	2	0,220
16	Dependence on middlemen and unfair distribution	0.167	2	0,334
	Subtotal	**0,296**		**1,060**
	Total	**1,000**		**2,833**

Sources: 2025 Research

The Internal Factor Evaluation (IFE) matrix analysis indicates that small-scale fisheries management in Tegal Regency is considered quite strong, with a score of 2.866 out of 4. The sector's primary strengths are the presence of the Larangan and Suradadi Fisheries and Fisheries Ports (TPI), which support economic activities and catch marketing. Therefore, institutional strengthening, human resource capacity building, and port infrastructure improvements are needed to support sustainable fisheries management.

The External Factor Evaluation (EFE) matrix analysis indicates that small-scale fisheries management in Tegal Regency is in a fairly supportive external environment, with a score of 2.833 out of 4. Key opportunities come from government support through the Fishermen's Insurance program, training, and the Special Allocation Fund (DAK). However, the sector still faces threats such as dependence on middlemen, trade system imbalances, climate change, erosion, and the Measured Fishing (PIT) policy, which is not yet understood by fishermen.

Formulating Alternative Strategies

The formulation of alternative strategies can be obtained by combining each component of internal factors (Strengths and Weaknesses) and external factors (Opportunities and Threats) using a SWOT matrix. The SWOT matrix combines Strengths – Opportunities (SO); Weaknesses – **Opportunities** (WO); Strengths – Threats (ST); and Weaknesses – Threats (WT). The results of the formulation of alternative strategies for small-scale capture fisheries management in Tegal Regency are presented in Table 8.

Table 8. Formulation of alternative strategies for small-scale capture fisheries management in Tegal Regency**.**

IFAS / **EFAS**	**Strengths (S)** • Availability of active fishing ports (PPP Larangan and Suradadi) • Availability of TPI and catch auction facilities • Traditions and experience of local fishermen • Potential of Tegal's seas for catch production (pelagic fish, demersal fish, crab)	**Weakness (W)** • Lack of access to capital and institutional capacity for fishermen (KUB/KUD are inactive) • Lack of CBIB/PIT outreach and technical training • Inadequate port facilities (cold storage, damaged facilities) • Suboptimal management of ship waste and port cleanliness
Opportunities (O) • Support from government programs (Fishermen's Insurance, Training Programs, Special Allocation Funds, etc.) • Potential domestic and export markets for marine products (crab, fresh fish) • The active role of HNSI in advocating for fishermen • Consumer preferences	**STRATEGIES S-O** 1. Optimize the utilization of active ports and fisheries processing facilities (TPI) to support government programs such as fisherman training and fisherman insurance. 2. SO2 = Increase the added value of catches through export market access and consumer preference by strengthening the supply chain and cold storage. 3. Actively involve HNSI (Indonesian Fisheries Association) in the socialization of government programs and fisherman empowerment at the joint business group (KUB) level.	**STRATEGIES W-O** 1. Utilize government training program support to strengthen human resources and provide outreach on CBIB and PIT. 2. Encourage the reactivation and legalization of KUB/KUD through collaboration with HNSI and the Fisheries Service. 3. Build cold storage infrastructure and improve TPI facilities through the Special Allocation Fund (DAK) from the central government.

Threats (T)	STRATEGI S-T	STRATEGI W-T
• Climate change and extreme weather • Fishermen do not fully understand the PIT policy • Abrasion and sedimentation in harbor estuaries • Dependence on middlemen and unfair distribution	1. Leverage the institutional strengths of fisheries processing facilities (TPI) and ports to develop a transparent and equitable catch distribution system to reduce dependence on middlemen. 2. Improve monitoring and management of port ecosystems to address abrasion, sedimentation, and the impacts of extreme weather. 3. Integrate information technology at ports to educate small-scale fishers about fisheries (PIT) policies and weather forecasts.	1. Develop local regulations to promote transparency in catch distribution and prevent monopolistic practices by middlemen. 2. Develop a roadmap for port rehabilitation and community-based abrasion mitigation. 3. Adopt a collaborative approach with extension workers, HNSI (National Fisheries Association), and the government to disseminate the PIT policy in stages and in local languages.

Resources: 2025 Research

Grand Strategy Formulation

The grand strategy formulation was determined based on the results of the IFAS and EFAS matrices to determine the appropriate strategy for small-scale capture fisheries management in Tegal Regency. The IFAS matrix determines the location of the X-axis, while the EFAS matrix determines the location of the Y-axis. Based on the analysis, the Strengths score was 1.852 and the Weaknesses score was 1.014. Therefore, the X-axis (the sum of Strengths and Weaknesses) was 2.866. The Opportunities score was 1.733 and the Threats score was 1.060. This resulted in a Y-axis (the sum of Opportunities and Threats) of 2.833. Referring to the X- and Y-axes, the SWOT quadrants are as follows. The SWOT Quadrant Diagram is presented in Figure 6.

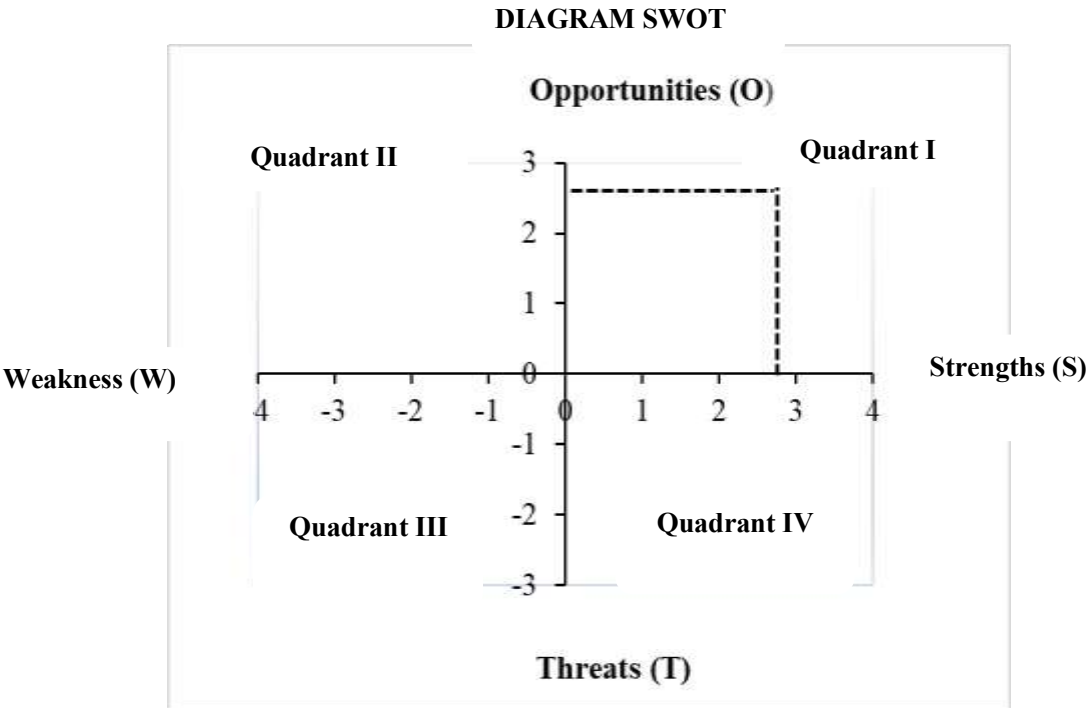

Figure 6. SWOT Quadrant Diagram

Based on Figure 6, the small-scale capture fisheries management strategy in Tegal Regency waters is positioned in quadrant I, or the S-O strategy. This is an effective strategy

implemented by leveraging Strengths (S) to optimize existing Opportunities (O). Internal and external factors in quadrant I require an aggressive strategy (growth-oriented strategy).

Table 9. Alternative SWOT Strategy Formulation

SO Strategies	Strategy Alternatives
SO 1	Optimizing the utilization of active ports and fisheries processing facilities (TPI) to support government programs such as fisherman training and fisherman insurance.
SO 2	Increasing the added value of catches through export market access and consumer preference by strengthening the supply chain and cold storage.
SO 3	Actively involving HNSI (Indonesian Fisheries Association) in the socialization of government programs and fisherman empowerment at the joint business group (KUB) level.

Resources: 2025 Research

DISCUSSION

Produksi dan Produktivitas Alat Tangkap

The production volume of each catch tends to fluctuate annually. Anchovy fishing in Tegal uses gemplo and payang fishing gear. According to Irnawati *et al.,* (2020), anchovies are a small pelagic fish species with high economic value. Anchovy fishing in several areas typically uses floating lift nets, fixed lift nets, and mini purse seines.

The highest production of swimming crabs occurred in 2021, reaching 75 tons per year. Shalichaty *et al.,* (2021) confirmed the dominance of folding traps (badong) in the swimming crab fishing effort in Tegal. The highest catch of jerbung shrimp is achieved using trammel nets. Suman and Prisantoso (2017) explain that jerbung shrimp are an economically important shrimp in the waters of Tegal and the surrounding area. The contribution of jerbung shrimp production in these waters is around 30 – 50% in terms of production and 50 – 70% in terms of production value.

The production of skipjack tuna and mackerel landed at the Larangan and Suradadi fisheries (TPI) in Tegal Regency is captured using fishing rods and nets. The study noted bycatch of skipjack tuna (Auxis thazard) and mackerel (Scomberomorus spp.), indicating that the nets used also have the potential to catch commercial-quality pelagic fish.

The equipment used to catch rebon shrimp in Tegal waters is arad net. Rebon shrimp are utilized by the Tegal community as the main ingredient in shrimp paste production. According to Masud *et al.,*, (2020), anchovies are preserved products made from fresh rebon fish or shrimp that have been processed through a grinding or pounding process, followed by drying, which lasts approximately one week.

The dominant fishing gear types are gemplo, badong, trammel net, fishing line, payang, and arad. Gemplo fishing gear shows the highest productivity (0.59 tons/trip). Fishing lines are the most selective fishing gear. This gear generally targets large, high-value fish such as red snapper (Lutjanus campechanus), grouper (Epinephelus spp.), and mackerel (Scomberomorus commerson). Fishing lines are the primary choice for small- to medium-scale fishing businesses that prioritize catch quality over quantity. Fishing lines are also environmentally friendly because they produce little bycatch, as explained in the study by Wahju *et al.,* (2020) on fishing gear selectivity.

In general, the diversity of catches indicates that fishermen in Tegal Regency utilize a variety of fishing gear appropriate to the characteristics of the waters and the fishing season.

To maintain the sustainability of marine resources, ecosystem-based management and the application of sustainable fisheries principles, such as gear selectivity and minimum catch size regulations, are crucial (KKP, 2020; Shalichaty *et al.*, 2021).

Productivity, the result of fishing effort for each type of fishing gear, is used as an indicator of the level of technical efficiency relative to the amount of effort expended. A high CPUE value indicates a more significant level of effort efficiency (Carles, 2014).

The decline in CPUE with increasing effort across various fishing gear types in Figure 4.5 reflects high fishing pressure on fish resources. According to the FAO (2022), a continuously declining CPUE value is often used as an indicator of declining fish stocks due to fishing intensity that is not balanced with the regenerative capacity of the fish population. This indicates that the fisheries system in the study area tends towards overfishing, particularly with fishing gear such as trammel nets and hook and line, which have a strong regression relationship between CPUE and effort.

Ecologically, greater effort exerted without considering fish population dynamics will lead to stock depletion, ultimately reducing fishing gear productivity. As Pauly *et al.,* (2021) noted, a decline in CPUE is a natural response of fisheries systems to exploitation exceeding the sustainable threshold. In this regard, fishing gear such as trammel nets, which exhibit a nearly perfect R^2 value (0.9678), deserves attention because their catch depends heavily on effort, and increases in effort are not matched by increases in catch.

On the other hand, fishing gear such as arad and payang showed a weaker relationship, which could be due to other external factors such as season, target species, oceanographic conditions, and variations in fishermen's operational techniques. This reinforces the view of Hilborn & Walters (2013) that CPUE is influenced not only by the amount of fishing effort, but also by environmental dynamics and technological adaptation. To maintain fisheries sustainability, adaptive effort management is necessary. Efforts such as limiting the number of trips, rotating fishing gear, regulating fishing seasons, and using environmentally friendly technologies must be implemented. The FAO (2022) recommends an ecosystem-based approach (EAF—Ecosystem Approach to Fisheries) that integrates socio-economic, ecological, and institutional aspects to prevent long-term CPUE decline.

Socioeconomic Profile of Fishermen

Most fishermen have low levels of education, with 91.67% having only elementary school degrees. According to Almu *et al.,* (2018), human resources in the fisheries sector are generally weak, reflected in the workforce structure and low education levels. Fishermen's awareness of children's education remains low. The age distribution is dominated by the 46–55 age group (50%). Generally, fishing is a profession passed down from generation to generation.

The average income of fishermen ranges from Rp 2,191,161 – Rp 4,236,000/month, categorized as a medium income level. The financing pattern of fishing businesses generally still relies on the "ijon" system or capital from collectors (bakul). Fishermen's income levels are influenced by several factors, including fishing experience, length of fishing gear operation, business capital, and the selling price of the catch. According to Ruswanty *et al.,* (2019), fishermen's income can be influenced by environmental conditions, fishing technology (fishing equipment), fishing capital, education, fishing experience, and age. Fishermen's income comes from net income from fishing. This means income that has not been deducted by fishing costs.

Small-Scale Capture Fisheries Management Strategy in Tegal Regency

The results of the IFAS (2.866) and EFAS (2.833) analyses place the strategy in quadrant I (aggressive). The S-O strategy is an effective strategy implemented by leveraging Strengths (S) to optimize existing Opportunities (O). Internal and external factors in quadrant I require

an aggressive (growth-oriented) strategy. The S-O strategy for small-scale capture fisheries management in Tegal Regency was developed with an aggressive (growth-oriented) approach, leveraging strengths such as active ports and fisheries processing facilities (TPI) and strong local institutions to respond to export opportunities, premium market preferences, and national government programs. The government, through the Tegal Fisheries Training and Extension Center (BPPP), has been increasing the human resource capacity of fishermen through standardized technical training and extension services from 2022 to 2024, targeting up to 58,000 fishermen over five years (2020–2024) (KKP, 2024).

On the institutional side, the Tegal City HNSI, active since 2025, has been promoting the use of environmentally friendly fishing gear and the inclusion of institutional aspects in fishermen's programs. The HNSI meeting with the Tegal Regency Government highlighted the importance of developing local ports, empowering fishermen's wives, and providing social protection (lifetime fishermen's insurance) to increase the income stability of fishermen's families (DJPT 2024). This initiative aligns with SO1 and SO3 strategies, namely utilizing TPI/ports for fishermen's training and insurance, and empowering HNSI/KUB for outreach and joint business group management.

CONCLUSION

The conclusions that can be drawn from this study are as follows:

1. Fishing Gear Productivity: Fishermen in Tegal Regency use various types of fishing gear, with the highest productivity being the gemplo net (0.59 tons/trip) and the lowest being the badong net (0.198 tons/trip). The order of productivity, from highest to lowest, is: gemplo net, arad net, trammel net, fishing line, payang, and badong.
2. Demographic Profile of Fishermen: The majority of fishermen are classified as having low education (91.67% only graduated from elementary school), aged 46–55 years (50%), and have a moderate income.
3. Management Strategy: The IFAS and EFAS analyses place the management strategy in quadrant I (aggressive strategy/S-O). Priority strategies include optimizing ports and fisheries processing facilities (TPI) for government programs, increasing the added value of catches through market access and strengthening the supply chain, and actively involving the Indonesian National Fisheries Association (HNSI) in outreach and empowerment of fishermen at the KUB level.

ACKNOWLEDGEMENT

The author would like to express his gratitude to Allah SWT who always gives blessings and smoothness in conducting this research. Thanks are also conveyed to the Regional Representative Council (DPRD) of Tegal Regency, the Department of Marine Affairs, Fisheries and Animal Husbandry of Tegal Regency (Mr. Kurniawan Priyo Anggoro, SP., MM as Head of Capture Fisheries), the Regional Development Planning and Research and Development Agency (BAPPEDA and LITBANG), the Supervisor of Marine Resources and Fisheries (PSDKP) of Tegal Work Area, the Head of Fishermen's Group, Fisheries Extension Officers and Academics from Pancasakti University (UPS) Tegal, the Head of TPI Larangan and Suradadi as well as the Fishermen who became respondents in Larangan, Suradadi and Warureja.

REFERENCES

Adiyanto, F., Yuliana, E., & Sugianto, H. (2022). Analisis Strategi Pengelolaan Perikanan Tangkap Skala Kecil Menggunakan Pendekatan SWOT Dan AHP di Kabupaten Cilacap. *Jurnal Kebijakan Perikanan Indonesia*, 14(3), 201–213.

Almu, A., Wiyono, E. S., & Mulyani, D. (2018). Analisis Karakteristik Sosial Ekonomi Nelayan Skala Kecil di Pesisir Utara Jawa. *Jurnal Sosial Ekonomi Kelautan dan Perikanan*, 13(2), 99–110.

Badan Perencanaan Pembangunan Daerah dan Penelitian dan Pengembangan Kabupaten Tegal (Bappeda & Litbang Kab. Tegal). (2023). *Profil Wilayah Kabupaten Tegal Tahun 2023*. Pemerintah Kabupaten Tegal.

Bryhn, A. C., Königson, S., Lunneryd, S. G., & Bergström, U. (2021). An Ecosystem-Based Fisheries Management Approach for Sustainable Coastal Fisheries in The Baltic Sea. *Marine Policy*, 127, 104445. https://doi.org/10.1016/j.marpol.2021.104445

Carles, J. P. (2014). *Measuring Catch Per Unit Effort in Small-Scale Fisheries: A Practical Guide*. FAO Fisheries Technical Paper.

Creswell, J. W., & Poth, C. N. (2023). *Qualitative Inquiry and Research Design: Choosing Among Five Approaches* (5th ed.). California: SAGE Publications.

Dinas Kelautan dan Perikanan Kabupaten Tegal. (2021). *Laporan Statistik Perikanan Tangkap Kabupaten Tegal Tahun 2021*. DKP Kabupaten Tegal.

FAO. (2020). *The State of World Fisheries and Aquaculture 2020*. Food and Agriculture Organization of the United Nations.

FAO. (2022). *The State of World Fisheries and Aquaculture 2022: Towards Blue Transformation*. Food and Agriculture Organization of the United Nations.

Gonzalez, J., Salas, S., & Poot-López, G. (2018). Social Resilience in Small-Scale Fisheries: A Framework for Analysis and Assessment of The Role of Fisheries Management Systems. *Marine Policy*, 95, 158–167.

Gullestad, P., Blom, G., Bakke, G., & Boe, R. (2017). The "Discard Ban Package": Experiences in Efforts to Improve the Exploitation Patterns in Norwegian Fisheries. *Marine Policy*, 78, 19–28.

Hilborn, R., & Walters, C. J. (2013). *Quantitative Fisheries Stock Assessment: Choice, Dynamics and Uncertainty*. Berlin: Springer.

Imron, M., Kusumawati, R., & Rofiq, M. (2021). Efektivitas Alat Tangkap Payang di PPP Larangan, Kabupaten Tegal. *Jurnal Teknologi Perikanan dan Kelautan*, 12(1), 37–49.

Irnawati, N., Nurdin, S., & Puspita, R. (2020). Studi Penangkapan Ikan Teri (Stolephorus spp.) di Perairan Pantura Jawa Tengah. *Jurnal Perikanan Tangkap Indonesia*, 8(2), 75–84.

Karim, M. S., Wahab, M. A., & Islam, M. M. (2020*).* Ecosystem-based Fisheries Management: A Holistic Approach to Sustainable Fisheries in Developing Countries. *Ocean & Coastal Management*, 184, 105018.

Kementerian Kelautan dan Perikanan Republik Indonesia (KKP). (2020). *Pedoman Umum Pengelolaan Perikanan Berkelanjutan*. KKP RI.

Kementerian Kelautan dan Perikanan Republik Indonesia (KKP). (2024). *Laporan Kinerja Balai Pelatihan dan Penyuluhan Perikanan (BPPP) Tegal Tahun 2024*. KKP RI.

Mardyani, A., Supriyadi, & Setiawan, I. (2019). Karakteristik Armada Penangkapan Ikan Skala Kecil di Pesisir Utara Jawa. *Jurnal Teknologi Perikanan dan Kelautan*, 10(2), 55–63.

Masud, S., Isnawati, A., & Hidayat, T. (2020). Teknologi Pengolahan Terasi Tradisional Berbasis Udang Rebon di Pesisir Utara Jawa. *Jurnal Teknologi Hasil Perikanan Indonesia*, 23(1), 22–31.

Pauly, D., Zeller, D., & Palomares, M. L. D. (2021). Fishing Down and Rebuilding Marine Ecosystems. *Nature Reviews Earth & Environment*, 2(8), 600–615.

Rangkuti, F. (2023). *Analisis SWOT: Teknik Membedah Kasus Bisnis (Edisi Revisi)*. Jakarta: Gramedia Pustaka Utama.

Ruswanty, E., Fitriani, S., & Hamzah, M. (2019). Faktor-faktor Yang Mempengaruhi Pendapatan Nelayan di Perairan Sulawesi. *Jurnal Sosial Ekonomi Kelautan dan Perikanan*, 14(2), 133–145.

Saaty, T. L. (2022). *Decision Making for Leaders: The Analytic Hierarchy Process for Complex Decisions* (4th ed.). Berkshire: RWS Publications.

Shalichaty, M., Setyohadi, D., & Rachman, A. (2021). Analisis Teknis dan Ekonomi Usaha Penangkapan Rajungan Dengan Bubu Lipat di Tegal. *Jurnal Ilmu Perikanan Tropis*, 26(3), 221–231.

Simanjuntak, B., Yusrizal, & Dewi, H. (2024). Pendekatan Bioekonomi Dalam Pengelolaan Perikanan Tangkap Skala Kecil di Indonesia. *Jurnal Bioekonomi Perikanan*, 7(1), 25–39.

Siregar, N. (2016). Hubungan Pendidikan Orang Tua dan Kesadaran Pendidikan Anak di Komunitas Nelayan. *Jurnal Pendidikan dan Kebudayaan*, 21(1), 55–63.

Sudarmo, A., Yulianto, B., & Raharjo, H. (2016). Perumusan Strategi Pengelolaan Perikanan Tangkap di Kabupaten Tegal Menggunakan Analisis SWOT. *Jurnal Perikanan dan Kelautan Tropis*, 11(1), 49–60.

Sugiyono. (2023). *Metode Penelitian Kuantitatif, Kualitatif, dan R&D* (2nd ed.). Jakarta: Alfabeta.

Suman, A., & Prisantoso, B. I. (2017). Analisis Potensi dan Pemanfaatan Sumber Daya Udang di Pantai Utara Jawa. *Jurnal Penelitian Perikanan Indonesia*, 23(2), 89–100.

Vatria, E., Firdaus, M., & Abdullah, A. (2019). Profil dan Kontribusi Perikanan Skala Kecil Terhadap Ekonomi Pesisir Indonesia. *Jurnal Kebijakan Sosial Ekonomi Kelautan dan Perikanan*, 9(1), 13–26.

Wahju, R. I., Wijayanti, T., & Mardiah, D. (2020). Selektivitas Alat Tangkap Pancing Terhadap Ikan Konsumsi Bernilai Tinggi di Laut Jawa. *Jurnal Teknologi Perikanan dan Kelautan*, 11(2), 77–88.

Yin, R. K. (2023). *Case study research and applications: Design and Methods* (7th ed.). California: SAGE Publications