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## Proceedings of the International Conference on Sustainable Environment, Agriculture and Tourism (ICOSEAT 2022)

PROCEEDINGS OF THE INTERNATIONAL CONFERENCE ON SUSTAINABLE ENVIRONMENT, AGRICULTURE AND TOURISM (ICOSEAT 2022)

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#### Abstract

All of the articles in this proceedings volume have been presented at the ICOSEAT during July 21-23, 2022 in Bangka, Indonesia. These articles have been peer reviewed by the members of the Scientific Committee and approved by the Editor-in-Chief, who affirms that this document is a truthful description of the conference's review process.

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# Proceedings of the International Conference on Sustainable Environment, Agriculture and Tourism (ICOSEAT 2022)

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## PREFACE

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Conference name: Proceedings of the International Conference on Sustainable Environment, Agriculture and Tourism (ICOSEAT 2022)

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Location: Bangka, Indonesia (Hybrid)

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PREFACE It is our great pleasure to host the International Conference on Sustainable Environment, Agriculture and Tourism (ICOSEAT), July 21-23, 2022, and welcome you all to Bangka Island, one of the most wonderful places in Indonesia. ICOSEAT is a collaboration event among Universitas Gadjah Mada, Government of Bangka Regency Province of Bangka Belitung, Universitas Bangka Belitung, Polytechnic State of Manufacturing Bangka Belitung, and Institute of Social and Political Sciences Pahlawan 12 Bangka Indonesia which held in a hybrid.

About 250 people are participating in ICOSEAT, 170 as a presenter and about 80 as an attendant from Indonesia and 11 foreign countries such as the USA, Portugal, Austria, Netherlands, Japan, Singapore, South Korea, Taiwan, Thailand, Malaysia, and Vietnam. The theme of this conference is "Agro-Industry 4.0, Tourism and Supportive Government for Sustainable Development". Through this conference, we engaged Academic, Business, and Government in an open and constructive dialogue about Agroindustry and Appropriate Technology 4.0; Environmental and Mining Engineering; Sustainable Development and Tourism Management; Agriculture and Food Engineering; and Marine, Aquaculture, and Biological Science. ICOSEAT is a means for universities, research institutions, industry, and the government to introduce their innovations in solving various problems and challenges in realizing the ideals of sustainable development.

I would like to thank all committee members, especially from Universitas

Gadjah Mada, The Government of Bangka Regency Province of Bangka Belitung, Universitas Bangka Belitung, Polytechnic State of Manufacturing Bangka Belitung, and the Institute of Social and Political Sciences Pahlawan 12 Bangka Indonesia, and others who generously helped us make this event a success. I would also like to express my truthful appreciation to all of you presenters, speakers, and participants who have joined ICOSEAT 2022. I am certain that every presenter has presented their experience. I sincerely hope that through your presentation and discussion afterward, all of us can contribute to solve the problems in our own countries. Even though the contribution may be small, it is still valuable. Furthermore, I would like to thank our sponsors especially PT Timah, PT Bangka Asindo Agri, PT Refined Bangka Tin, PT Telkom, PT Putra Bangka Mandiri, Bank sumsel babel sungailiat, PT. Karini Utama, and PT. Payung Mitrajaya Mandiri for all the support.

I am extremely pleased that the ICOSEAT was well attended by participants from various stakeholders ranging from government officials, policymakers, industry practitioners, and experts from universities and research institutes. I believe that during the conference, all of us have obtained a fruitful discussion. We have learned a lot from the keynote sessions delivered by our amazing speakers. Once again, on behalf of the committee, thank you for delivering such important materials so that all of us can deepen our knowledge.

Best Regards,  
Chandra Setyawan, Ph.D.  
Chairperson of ICOSEAT 2022

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# Small-scale Fisheries Management Strategy on the Eastern Coast of the Bangka Regency, Indonesia

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## ABSTRACT

The spatial allocation arrangement for the utilization of the eastern coastal area of the Bangka Regency, based on the Zoning Plan for Coastal Zone and Small Islands (RZWP3K) is multipurpose and multi-sector. The simultaneous use of marine space creates a trade-off for interested economic actors, which will lead to conflicts of interest. Small-scale fisheries as a marginal group tend to receive pressures due to externalities in spatial use conflicts. This study aims to formulate a sustainable small-scale fisheries management strategy through a SWOT analysis that can be an input for small-scale fisheries management policies. The research method is a survey based on case studies, which was carried out in-depth on individual small-scale fishers in Deniang Village (Riau Silip District), Rebo Village, and Matras Village (Sungailiat District). Small-scale fisheries management strategies based on strategic priority order are improving fishery business facilities and infrastructure (weight 0.44); using information technology when fishing (weight 0.06); optimizing the fishing fleet (weight 0.19); and optimizing the cooperation relationships for funding assistance from the private sector or banks (weight 0.31).

**Keywords:** RZWP3K, Small-Scale Fisheries (SSF), SWOT, Bangka Regency.

## 1. INTRODUCTION

The coastal area as an open-access resource has the potential for conflicts in spatial utilization [1], [2]. In the context of the utilization of coastal resources as fishery resources, the condition of open-access fisheries resources and the desire to increase business profits through high production are pressures for fisheries resources. The sustainability of fisheries faces not only the problems of overfishing and overcapacity but also resource degradation that increases the vulnerability of fishers and the sustainability of their businesses, as well as various conflicts over the use of coastal areas [1,3], [4].

In addition to problems related to open access resources in small-scale fisheries, fishers also face problems regarding access to the use of water areas with actors of other sectors, who also utilize existing resources on the coast and the sea [5]. Small-scale fishing

communities are also under pressure due to unequal power relations. In various places, one of the problems the communities must face is the conflict with large-scale fishing operations and the increasing linkages or competitions with other sectors that have stronger political and economic influences (tourism, aquaculture, agriculture, energy, mining, industry, and infrastructure development) [6].

In general, fishers in Indonesia face the same problems related to low access to financial capital, pressure from financial capital lenders (middlemen), injustice in profit-sharing rules, a non-transparent fish auction system and the inability of the government to fully enforce the regulations [7,8]. Those problems are caused by the fact that the nature of the business being run is more subsistence and is a hereditary job, so there is little or no effort by fishers to adopt the latest innovations in improving the quality of life [9].

As an archipelagic region, the fisheries sector is one of the economic bases for regional development in the Bangka Belitung Islands Province in accordance with the regional development mission in its Regional Medium-Term Development Plan (RPJMD). Fisheries resources in the waters of the Bangka Belitung Islands Province are included in the State Fisheries Management Area of the Republic of Indonesia (FMA) 711 based on the Decree of the Minister of Maritime Affairs and Fisheries Number 50/KEPMEN-KP/2017 concerning The Estimation of Potential, Amount of Allowed Catch, and Utilization Level of Fish Resources in the State Fisheries Management Area of the Republic of Indonesia, with a total potential of fish resources in FMA 711 of 767,126 tons. Based on statistics from the Office of Fisheries and Marine Affairs (OFMA) of the Bangka Belitung Islands Province (2020), the fisheries sector dominates more than 90% of the overall regional fisheries and aquaculture production in the Province of the Bangka Belitung Islands, of which more than 51% is small-scale fisheries with fishing fleets less than 5 GT.

Fishers in the Bangka Regency are mostly small-scale fishers [10]–[12]. The eastern water of the Bangka Regency is one of the fisheries areas, mainly small-scale fisheries. Based on the RZWP3K of the Province of the Bangka Belitung Islands, the eastern water of Bangka Regency is a fishing zone (KPU-PT), particularly the pelagic sub zone (KPU-PT-P), and also the fishing grounds (DPI) for small fishers or artisanal fishers. Meanwhile, the eastern water of the Bangka Regency is also included in the Mining Zone (KPU-TB), particularly the mineral mining sub-zone (KPU-TB-MN). This condition triggered conflicts in the use of the coastal area between fishers and offshore mining business actors [13]–[17], which brought pressure on the economic

conditions of small fishers on the eastern coast of the Bangka Regency [10].

Internal and external factors of fisheries management affect fisheries activities. Effective and appropriate management strategies can have a positive influence on the social and economic conditions of fishing communities, especially small-scale fishers [18]. In order to protect the sustainability of small-scale fishery businesses, as mandated by the Job Creation Act, which amends Law Number 1 of 2014 concerning Amendments to Law Number 27 of 2007 concerning Coastal Management and Small Islands, a small-scale fisheries management strategy is required through the elaboration of internal and external factors that affect the management of the fisheries sector in the eastern coastal area of the Bangka Regency so that it can be used as an input to the fisheries management policies in the Province of the Bangka Belitung Islands.

## 2. MATERIAL AND METHOD

### 2.1. Research Area

The research was conducted on the eastern coast of the Bangka Regency, which is a small fishing center that includes Deniang Village (Riau Silip District), Rebo Village, and Matras Village (Sungailiat District). The locations of this research were determined purposively, with the consideration that the eastern waters of the Bangka Regency are fishing ground (DPI) for small-scale fisheries, which are directly adjoining to the tin mining concession (IUP) around the eastern coastal waters of Bangka Island. The research location can be seen in Figure 1. The data collection was carried out from March to July 2021.

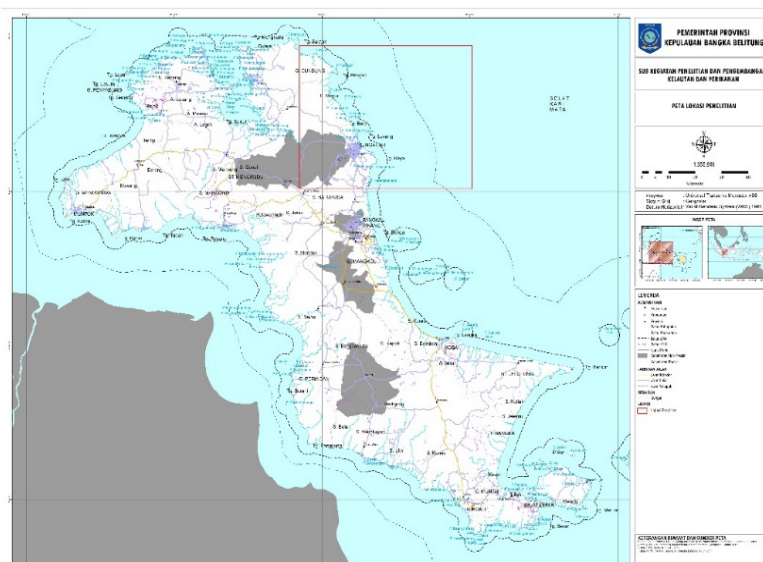


Figure 1 Research location

## 2.2. Data and Analysis

This research uses a survey method by collecting data and information using a questionnaire as a data collection instrument [19]. The primary data collected were data on internal factors (strengths and weaknesses) and external factors (opportunities and threats) in fisheries management in the Bangka Regency. Primary data was collected through interviews with competent key informants to determine the SWOT variables as well as alternatives and priorities for implementing strategies. The secondary data collected are data on the use of fishing gear, fishing facilities, and marine fishery production. Respondents were selected by purposive sampling, based on the expertise of the respondents [20], who are officers of the Office of Fisheries and Marine Affairs of the Bangka Belitung Islands Province, village chiefs as well as *lurah* (urban village chief), fishers, and collectors.

## 2.3. SWOT Analysis

Sustainable small-scale fisheries management strategies are formulated using a SWOT analysis approach. SWOT Analysis was used to inventory and evaluate the strengths (S), weaknesses (W), opportunities (O), and threats (T) [21,22]. SWOT analysis deals with the internal process analysis and the external

environment with the identifying internal forces aim to take advantage of the external opportunities, and avoid the external threats while overcoming internal weaknesses [23], and become one of the most widely used methods in the strategy-making process [24], [25]. In many marine fisheries studies, SWOT is often used to determine management development strategies [18,21,23], [26–33].

The SWOT analysis procedure [18] is carried out through the following stages: 1) determining internal factors (strengths and weaknesses) and external factors (opportunities and threats); 2) determining the weight and rating of each internal factor and external factor; 3) determining the weighted score by multiplying the weight values of x rating, the SWOT assessment criteria for an activity can be continued if the total IFAS score > 2 and the total EFAS score > 1; 4) compiling the Internal Strategic Factors Analysis Summary (IFAS) matrix and the External Strategic Factors Analysis Summary (EFAS) matrix; 5) drawing up a SWOT diagram, and 6) compiling a SWOT matrix.

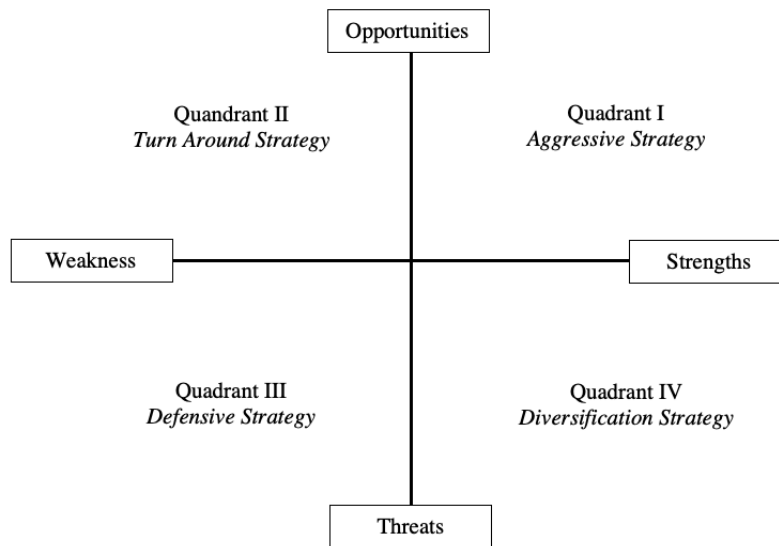
The determination of the grand strategy is carried out using scoring calculations for internal and external factors, then the scores are entered into the grand strategy matrix or SWOT quadrant. The calculation to determine the strategy used is as follows:

$$\frac{\sum \text{Strength Score} - \sum \text{Weakness Score}}{2}; \frac{\sum \text{Opportunity Score} - \sum \text{Threat Score}}{2} \quad (1)$$

Based on the results of scoring calculation, a grand strategy matrix for small-scale fisheries management on the eastern coast of Bangka Island can be generated as shown in Figure 2.

Space matrix analysis is used to sharpen sustainable small-scale fisheries management strategies. By analyzing the space matrix, the combination of internal and external factors in the quadrants of the created space matrix can be seen. In deciding to choose SWOT (Strength, Weakness, Opportunity, and Treats), alternative strategies should be carried out after the

quadrant position of a development area on the space matrix is identified in advance. By identifying the quadrant position of a development area, the strategy to be taken will be more appropriate and suitable with the current internal and external conditions of the region. The quadrant position of a development area can be grouped into 4 (four) quadrants, namely Quadrants I, II, III, and IV. In quadrant I, the proper strategy is aggressive, the strategy for quadrant II is diversification, quadrant III is a turnaround strategy, and quadrant IV is a defensive strategy [34]. The position of a development area in four quadrants with annotations is presented in Figure 2.



**Figure 2** Quantified SWOT analysis and the strategic matriks (Rangkuti 2006).

Quadrant I indicates a very favorable position, where a development area has strengths and opportunities that it can take the benefits of existing opportunities by implementing an aggressive growth strategy. Quadrant II shows that a development area faces various threats but still has strength, therefore the proper strategy to apply is to use the strength to benefit the long-term opportunities by implementing a diversification strategy. Quadrant III shows a very big opportunity but also internal weaknesses. In this situation, a development area should minimize the internal problems to seize market opportunities. Quadrant IV shows that a development area is in an unfavorable position because it has to face threats as well as internal weaknesses.

The SWOT matrix above clearly illustrates how external opportunities and threats faced by fishing business units can be adjusted to their strengths and weaknesses [34]. From the matrix, four possible alternative strategies will be made.

- 1) S–O (Strengths – Opportunities) strategy. This strategy is prepared by using all the existing strengths and opportunities.
- 2) W–O (Weakness – Opportunities) strategy. This strategy is implemented based on the existing opportunities, by overcoming the existing weaknesses. Great opportunities come up sometimes, but the fishing business unit has internal weaknesses that prevent it from taking advantage of these opportunities.
- 3) S–T (Strengths – Threats) strategy. This strategy uses the strengths of a fishing business unit to avoid or reduce the impact of external threats.

W–T (Weakness – Threats) strategy. This is a defensive strategy to reduce internal weaknesses and avoid external threats.

### 3. RESULT AND DISCUSSION

#### 3.1. Overview

The eastern coast of the Bangka Regency is one of the fish landing centers dominated by small-scale fisheries. Based on data from the Statistic Office of the Bangka Regency (2021) and OFMA of the Bangka Belitung Islands Province (2021), until 2020 the population of the Bangka Regency with fishing livelihoods is still quite large, reaching 6,721 people out of a total population of 326,265 people, which is dominated by small fishers. The fishing fleet is dominated by 1,559 outboard motorboats and 735 motorboats under 5 GT out of a total of 2,742 fishing boats in the Bangka Regency. Non-port fisheries production with catches from small-scale fishery landing centers reached 26,994.78 tons in 2020 with a production value of IDR 1,061,996,160.49 [10].

Small-scale fishers on the eastern coast of the Bangka Regency are categorized based on the size of the boat and the fishing gear used. In Bedukang Village, on average, fishers use outboard motorboats with the capacity of 5-15 hp with hand lines and stationary lift nets. Fishers in Matras Village use outboard motorboats of 5-15 hp with drift gill nets and hand lines as dominant fishing gears, while, fishers in Rebo Village predominantly use outboard motorboats with 40-50 hp capacity with hand lines and stationary lift nets (Table 1)

**Table 1.** Characteristics of Small-scale Fishers in the Eastern Coast of the Bangka Regency

Village	Type of dominant fishing gears	Type of Fishing Boat	Dominant Catch
Bedukang	Hand line, Stationary lift net	Outboard Motorboat 5-15 hp	Spanish mackerel ( <i>Scomberomorus sp.</i> ), Squid ( <i>Loligo spp.</i> ), Stingray ( <i>Dasyatis sp.</i> ), Sea catfish ( <i>Arius thalassinus</i> ).
Matras	Drift gill net, Hand line	Outboard Motorboat 5-15 hp	Yellowstripe scad ( <i>Selaroides leptolepis</i> ), Kurisi/ Ornate Threadfin bream ( <i>Nemipterus furcosus</i> ), Spanish mackerel ( <i>Scomberomorus sp.</i> ), Dorab Wolf - Herring ( <i>Chirocentrus dorab</i> ), Blue lined Seabass ( <i>Epinephelus sp.</i> ), Red snappers ( <i>Lutjanus sp.</i> )
Rebo	Hand line, Stationary lift net	Outboard Motorboat 40-50 hp	Anchovy ( <i>Stolephorus sp.</i> ), Goldstripe sardinella ( <i>Sardinella gibbosa</i> ), Squid ( <i>Loligo spp.</i> ), Spotted Sardinella ( <i>Amblygaster sirm</i> ).

Source: processed primary data (2021)

### 3.2. Identifying Internal and External Factors

The identification of internal and external factors was carried out based on in-depth interviews with key informants and the results of field observations. The interview results indicate that there are several internal

and external factors in the preparation of sustainable small-scale fisheries management strategies, as presented in Table 2.

**Table 2.** Internal and External Factors Identification for sustainable small-scale fisheries management

Internal Factors		External Factors	
<b>Strengths</b>		<b>Opportunities</b>	
1	The majority of the community is main fishers	1	Annual market demand increase
2	Fisher groups and fisher cooperatives exist	2	Funding assistances from the private and banking sectors are available to help improve the welfare of the fishers
3	Fishing gears used by fishers are still traditional and environmentally friendly	3	There has been cooperation between local government and investors that start to see the fishery potential on the eastern coast of Bangka Island
4	Fish resource potential is abundant and the economic value of the fish production is high	4	There are central government supports and assistance programs in improving fishers' welfare, such as aid programs for fishing gear and machinery in developing fishery businesses
<b>Weakness</b>		<b>Threats</b>	
1	Fishers suffer lack of funding that make them take the loan for their business from the <i>tauke</i> /boss (middleman)	1	The use of fishing gears that are not environmentally friendly
2	The capacity of the fishing fleets is still under <5GT	2	The funding provider institutions are limited so that the fishers are dependent on the loan offer from the <i>tauke</i> /boss (middlemen)
3	The fishing ground is getting farther	3	Conflicts of interest with other sectors (mining) frequently happen
4	The existing infrastructure and facilities (piers, cold storage, and solar pack dealer) have not met the needs of fishers.	4	There are foreign fishers' encroachment operating fishing fleet with bigger capacity
5	The marketing is still limited and some fishery centers have not had fish auction site (TPI)	5	The environment of the waters is polluted

Source: processed primary data (2021)

Based on this identification, the internal and external factors of sustainable small-scale fisheries management can be explained as follows:

Strengths, which contain the strength factors that support sustainable small-scale fisheries management:

- 1) The majority of the community work as the main fisher; that is fisher with sufficient experience to carry out the profession. There 74% of fishers have >5 years of experience. Based on data from the Office of Marine Affairs and Fisheries of the Bangka Belitung Islands Province, more than 83% of fishers in the Bangka Regency are dominated by small-scale fishers using motorboats or motorized boats under 5GT.
- 2) Fisher groups have been established, and there are fisher cooperatives; Good coordination among fishers can minimize conflicts of interest. Fishers put forward deliberation for consensus in resolving problems that arise among them. In addition, the existence of fisher cooperatives makes it easier for the fishers to carry out fishing business activities.
- 3) The fishers still use traditional and environmentally friendly fishing gears; the fishing gears used by fishers in the waters of the eastern coast of Bangka Island are stationary lift nets, drift gillnets, and hand lines. Fishers operate those traditional fishing gears on small scales.
- 4) The potential of fish resources is abundantly available and the economic value of fishery production is high; the average fish production from the three locations annually was 23,128 kg or 23 tons, or 7.74% of the total capture fisheries production in the Bangka Regency in 2020. The highest production was from stationary lift nets with fish species like squid, yellow stripe scad, *laisi*, anchovy, oxeve scad, gold stripe sardinella, and spotted sardinella. The annual production value was 5,812.527,000 IDR.

The weakness factors that become obstacles in sustainable small-scale fisheries management consist of:

- 1) The lack of funding makes fishers take loans to fund their fishing activities from the *touke/boss* (middleman); limited funding has forced fishers to obtain loans from *touke / boss*. This system is usually called a profit-sharing system, where the *touke/boss* facilitates or lends some money for operational costs or fishing gear and fleets used by fishers. In return, the fishers must sell their catch to the *touke/boss* at a price determined by the *touke/boss*.
- 2) The fishing volume of the fishing fleet is still < 5 GT; the fishing gear used by fishers is not sufficient. Equipment is still traditional, without technology to find schools of fish or other fishing aids. The fishing boat fleet uses outboard motors for small boats so that the fishing range is not far (less than 4 miles).
- 3) The fishing ground is getting farther; fishers spend more production costs, mainly for diesel fuel

because fishing areas are getting farther as a result of mining activities on the coast. For example, the distance increases by 5 miles, from 15 miles to 20 miles, on the coast of Matras.

- 4) The available infrastructure and facilities have not met the needs of fishers (piers, ice factories, and solar pack dealers); the establishment of the pier is important to facilitate fishing activities. The existence of breakwater is also important to protect the fishers' boats so that they can be moored closer to the coast or fishing bases. In addition, fishers also need a fish auction site that enables them to sell their catch more efficiently and hygienically. Infrastructure facilities such as factories and solar pack dealers are still lacking, so they need to be added. Adding facilities and infrastructure will make it easier for fishers to fulfill their needs to develop their business. The piers can function as a place for fishing boats to rest when loading and unloading the catch. The existence of the pier will help fishers have access to do their business.
- 5) The selling is limited and the fish auction sites (FAS) are not available in some fishery centers; Due to the funding loan system with *touke/boss*, fishers can only sell their catches to their respective bosses. In general, the catches are sold to *touke*, middlemen, and the frozen fish companies. In addition, because there are no supporting facilities such as FAS, fishers sell their catches in makeshift locations, so it is necessary to make fish auction sites that are more efficient and hygienic.

Opportunity factors that can be utilized in sustainable small-scale fisheries management include:

- 1) The market demand is increasing every year; the types of fish caught are easily absorbed by the market and some of them have high economic value.
- 2) Funding assistance from the private sector and banks to help fishers improve their welfare are available; funding assistance program (i.e. people's business credit program/KUR) for fishing activities from stakeholders (private parties or banks) can help fishers carry out their activities and will also minimize their dependence on loans from *touke/boss*.
- 3) Cooperation with investors, who are starting to look at the fisheries potential on the eastern coast of Bangka Island, has started established; some investors are looking at the potential for fisheries in the Bangka Belitung Islands Province, one of which is squid resources. Fishers in the eastern coast dominantly use stationary lift nets, in which one of the main catches is squid. A cooperative relationship with investors will have many positive impacts on the welfare of fishers.
- 4) There are central government supports and assistance programs in improving fishers' welfare like assistance programs for fishing gears and machines in developing their fishing businesses, and

programs to obtain skills in order to improve their competencies.

Threat factors in sustainable small-scale fisheries management consist of:

- 1) Use of fishing gears that are not environmentally friendly; the use of non-environmentally friendly fishing gears such as trawlers are usually operated by foreign fishers, who deliberately use them on the waters around the eastern coast.
- 2) There are not many institutions that provide funding so the available facilities offered by bosses/*touke* make fishers dependent; access and the number of quotas to obtain loans from both the private sector and local or central governments are limited
- 3) There are frequent conflicts of interest with other sectors (mining); the government must enforce the RZWP3K so that the spatial allocation is in accordance with the local regulation that has been set

and continuously educate business actors with licensing matters.

- 4) There is the encroachment of foreign fishers operating larger fishing fleet capacity; this encroachment makes the catch of the local fishers decrease.

The aquatic environment is polluted; due to mining activities in the waters of Rebo and Matras, including increasing turbidity of the waters and sedimentation, the fishing ground is getting farther. In addition, the tides that are too far force fishers to moor their boats farther to avoid the boats going aground.

### 3.3. IFAS and EFAS Matrix

The IFE matrix is used to assess the influence of internal factors in the management of small-scale sustainable fisheries. The assessment results of internal factors analysis are presented in Table 3.

**Table 3.** IFAS Matrix

<b>Internal Factors</b>				
<b>No.</b>	<b>Strength (S)</b>	<b>Weight</b>	<b>Rating</b>	<b>Score</b>
1.	The majority of the community work as the main fisher.	0.1	3.2	0.32
2.	Fisher groups have been established, and there are fisher cooperatives.	0.1	3.7	0.37
3.	The fishers still use traditional and environmentally friendly fishing gears.	0.1	2.8	0.28
4.	The potential of fish resources is abundantly available and the economic value of fishery production is high.	0.1	3.2	0.32
<b>Total</b>				<b>1.29</b>
<b>Internal Factors</b>				
<b>No.</b>	<b>Weakness (W)</b>	<b>Weight</b>	<b>Rating</b>	<b>Score</b>
1.	The lack of funding makes fishers take loans to fund their fishing activities from the <i>touke/boss</i> (middleman).	0.1	3.6	0.36
2.	The fishing volume of the fishing fleet is still < 5 GT.	0.1	3.5	0.35
3.	The fishing ground is getting farther.	0.1	3.5	0.35
4.	The available infrastructure and facilities have not met the needs of fishers (piers, ice factory, and solar pack dealers).	0.1	3.5	0.35
5.	The selling is limited and the fish auction sites (FAS) are not available in some fishery centers.	0.1	3.6	0.36
<b>Total</b>				<b>1.77</b>
<b>Total SW (X)</b>				<b>-0.48</b>

Source: Processed primary data (2021)

The results of the IFE matrix analysis show that there are four attributes of strength and five attributes of weaknesses in the internal factor components. The score

of the strength factors assessment is 1.29 and the score for the weakness factors is 1.77. Overall, the score of internal factors is -0.48. The strength score is less than



the weakness score, and it can be concluded that small-scale fisheries have more weaknesses than strengths. According to David (2006) [39], if the average total score is below 2.5, it indicates that the position of internal factors is weak.

The establishment of fisher groups and the existence of fisher cooperatives are the biggest strengths of fishery business activities on the eastern coast of the Bangka Regency with a score of 0.37. Meanwhile, the use of traditional and environmentally friendly fishing gears by the fishers is the attribute in the strength factors with the weakest effect, with the value of 0.28. This shows that in optimizing the fishery business, it is necessary to improve or update the technology with appropriate modern fishing gear. Insufficient knowledge of appropriate fishing gear technology is one of the obstacles to maximizing profits.

The lack of fisher funding that causes fishers to take loans from touke (boss), limited sales, and the absence

FAS at several fishery centers are the weakness factors that have the strongest influence, with a value of 0.36. According to Setyaningsih (2018) [40], facilities and infrastructure are among the important facilities in supporting the implementing process of an activity. The available infrastructure and facilities that have not been able to meet the needs of fishers (piers, ice factories, and solar pack dealers) are weaknesses, with a low value of 0.25. This is because the facilities and infrastructure have not been optimal, especially the solar pack dealers provided by the government at each fishery center. In addition, the availability of fuel in the solar pack dealers is sometimes unable to meet the capacity of fishers forcing fishers to buy fuel at a higher price.

The influence of external factors in sustainable small-scale management is analyzed in the EFE matrix. The results of the external factors analysis are presented in Table 4.

**Table 4.** EFAS Matrix

<b>External Factors</b>				
<b>No.</b>	<b>Opportunity (O)</b>	<b>Weight</b>	<b>Rating</b>	<b>Score</b>
1	The market demand is increasing every year.	0.1	4	0.4
2	Funding assistance from the private sector and banks to help fishers improve their welfare are available.	0.1	3.6	0.36
3.	Cooperation with investors, who are starting to look at the fisheries potential on the eastern coast of Bangka Island, has started established.	0.1	3.8	0.38
4.	There are central government supports and assistance programs in improving fishers' welfare like assistance programs for fishing gears and machines to develop fishery businesses.	0.1	3.7	0.37
Total				1.51
<b>Faktor Internal</b>				
<b>No.</b>	<b>Threat (T)</b>	<b>Weight</b>	<b>Rating</b>	<b>Score</b>
1.	Use of fishing gears that are not environmentally friendly.	0.1	2.4	0.24
2.	There are not many institutions that provide funding so the available facilities offered by bosses/toukes make fishers dependent.	0.1	3.2	0.32
3.	There are frequent conflicts of interest with other sectors (mining).	0.1	2.9	0.29
4.	There is the encroachment of foreign fishers operating larger fishing fleet capacity.	0.1	2.5	0.25
5.	The aquatic environment is polluted.	0.1	2.9	0.29
<b>Total</b>				<b>1.39</b>
<b>Total SW (X)</b>				<b>0.12</b>

Source: Processed primary data (2021).

The results of the EFE matrix analysis show that the external factor consists of two components, which are the opportunity component with four attributes and the threat component with five attributes. The assessment score for the opportunity factor is 1.51, and the score for the threat factors is 1.39. Therefore, overall external factors have a score of 0.12. The opportunity score is greater than the threat score, and it can be concluded that small-scale fisheries have more opportunities than threats.

The biggest factor in the opportunities is that market demand increases every year with a rating value of 4. Types of caught fish can be absorbed in the market ranging from ones with low economic value to high economic value. The opportunity factor with the least effect is the establishment of cooperation with investors starting to look at the fishery potential of the east coast of Bangka Island, which has a rating value of 0.35. The limited number of funding providers that make fishers are dependent on the bosses/*touke* offering facilities is the biggest threat faced in the fishing business on the eastern

coast of Bangka Island, has a score of 0.32. The use of fishing gear that is not environmentally friendly is a threat factor with the smallest effect with a value of 0.24. Weak punishments for violations not only invite conflicts that occur in the community but also lead to overexploitation of aquatic ecosystems. Widowati (2015) said the existence of law as order and guidance in behaving in society, must be obeyed, and it has punishments when it is violated.

### 3.4. Management Strategy based on SWOT Analysis

Based on the IFAS and EFAS matrices, a SWOT matrix is obtained as the alternative strategy for small-scale fisheries management. The alternative strategies were chosen based on the opinion of key informants and the results of field observations (Table 5).

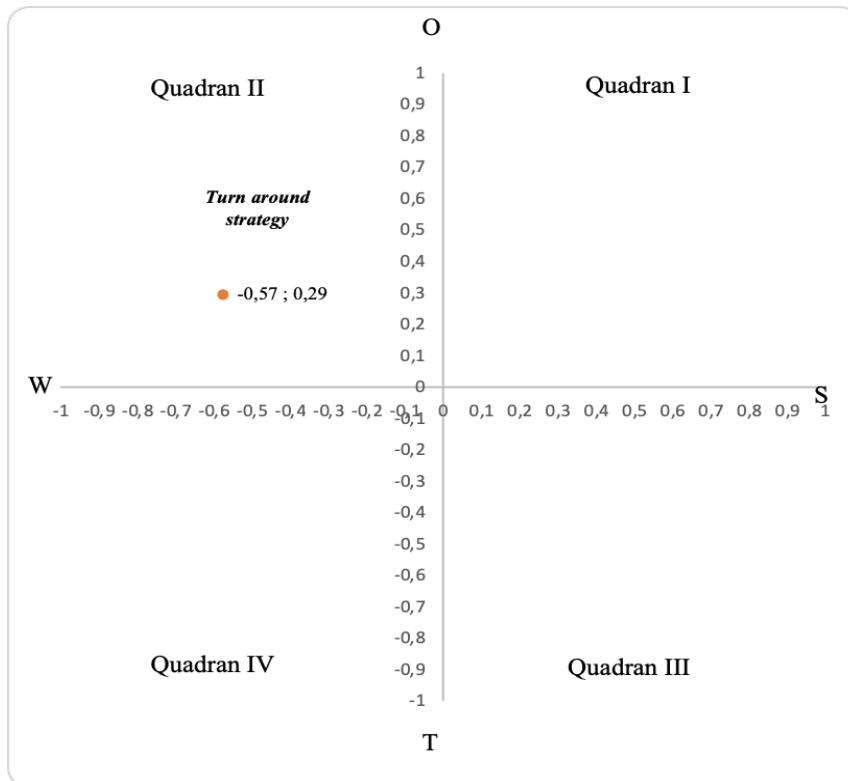
**Table 5.** SWOT Matrix

IFAS EFAS	Strength	Weakness
<i>Opportunity</i>	<ol style="list-style-type: none"> <li>1) [S1,S4;O1,O3] To optimize catch and cooperate with fisheries entrepreneurs in marketing catch.</li> <li>2) [S1,S3,S4;O2,O4] To optimize fisheries assistance programs to facilitate fishing business activities for fishers to increase fishing production.</li> <li>3) [S2,S3;O1,O4] To optimize the role of fishery extension officers in educating business actors by strengthening relationships with fishing groups to build a solid system among fishers and the central and regional governments.</li> <li>4) [S1,S2;O2,O3] To improve the quality of catch so that catch has higher economic value that attracts more investors.</li> </ol>	<ol style="list-style-type: none"> <li>1) [W2,W3;O1,O2,O4] To use information technology when fishing, including using navigational aids and sonar, so that fishers can go directly to the fishing ground and minimize operational costs.</li> <li>2) [W4,W5;O1,O5] To improve facilities and infrastructure, such as ice factories, solar pack dealers, and pers, by optimizing cooperation with local government and private parties in facilitating the fishing business.</li> <li>3) [W2,W3;O1,O5] To optimize the fishing fleet (ship payload) and modern fishing gear so that fish production can be optimally used.</li> <li>4) [W1,W3,W5;O1,O3] To optimize the cooperation relationship with funding assistance providers, like the private sector or banks (people's business credit), to facilitate the funding of fishers' fishing businesses and expand the reach of market share in selling the catch.</li> </ol>

<b>Threat</b>	<p>1) [W2,W4,W5;T1,T4] To optimize the function of existing facilities and infrastructure to support the fishing business.</p> <p>2) [W2,W3;T1] To provide information dissemination about environmentally unfriendly fishing gear and develop modern fishing gear and fleets.</p> <p>3) [W3;O3,O5] To enforce the RZWP3K so that the spatial allocation is in accordance with the enacted local ordinance, and to continuously disseminate the information regarding the natural resources utilization permits to business actors.</p> <p>4) [W1,W2;T2] To optimize funding assistance programs and appropriate profit-sharing system in obtaining profits so that the fish selling price is not too low and the catch marketing chain flow is not multilevel.</p>	<p>1) [S1,S2,S5; T3,T5] To enforce RZWP3K so that space utilization can be functioned optimally and avoid conflicts in natural resources utilization.</p> <p>2) [S1,S3,S4;T2] To optimize the role of the private sector through the people's business credit program so that fishers can obtain funding for their operational equipment.</p> <p>3) [S1-S4; T1,T4] To enforce the law and provide strict sanctions against the foreign fishers' encroachment, thereby minimizing illegal fishing and the use of environmentally unfriendly fishing gears.</p> <p>4) [S2,S4;T1,T3] To disseminate information and impose sanctions on zoning violations to fishers and miners to minimize social conflicts among communities.</p>
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Based on the IFAS and EFAS matrices and the determination of the grand strategy, the map of the position of small-scale fishery strength in the eastern

coast of the Bangka Regency is obtained at point x; y is - 0.48: 0.12 or in Quadrant II (Figure 3).



**Figure 3** Quadrant Matrix of SWOT Analysis Result

According to Rangkuti (2017) [35], the strategy used in Quadrant II is the (W-O) strategy, describing the situation that small-scale fisheries in the Bangka Regency have a very big opportunity to be developed by minimizing existing weaknesses. The strategy of

increasing the productivity of sustainable small-scale capture fisheries in improving the economy of fishermen in West Aceh Regency also uses the W-O strategy [30] as well as several combinations of W-O strategies such as in Tegal City [18] and Simeulue Regency [36]. The

quadrant results are the reference for determining priority strategies in dealing with external threats that arise in the small-scale fisheries management in the waters of the Bangka Regency.

The priority strategies for small-scale fisheries management in the waters of the Bangka Regency include:

- a) To improve facilities and infrastructure such as ice factories, solar pack dealers, and piers by optimizing cooperation with local governments and the private sector in facilitating the fishing business, with a weight of 0.44.
- b) To optimize cooperative relationships with funding assistance providers, like the private sector or banks (people's business credit) to facilitate the funding of fishers' fishing business and expand the reach of market share in selling the catch, with a weight of 0.31.
- c) To optimize the fishing fleet (ship payload) and modern fishing gear so that the fish production can be optimally used, with a weight of 0.19.
- d) To use information technology when fishing, including using navigational aids and sonar, so that fishers can go directly to the fishing ground and minimize operational costs, with a weight of 0.06.

Maintaining sustainable management of the fisheries sector so that fishery resources remain sustainable and there is no overfishing can be done by increasing business productivity and increasing the income and welfare of fishery sector actors (fishers) [37] through the development of fishing technology and fleets for local fishers by increasing the size and number of the fleet, and developing fish transportation and distribution systems through the program to increase the construction of ice factories, piers, and solar pack dealer so that the fish transportation and distribution system is expected to run effectively and efficiently [38].

#### 4. CONCLUSION

Based on the SWOT analysis, the priorities for the small-scale fisheries management strategy in the eastern waters of the Bangka Regency, both input and output strategies, namely (1) Improving facilities and infrastructure (ice factory, solar pack dealers, and piers); (2) Optimizing the cooperation relationships with funding assistance providers, from the private sector or banks (people's business credit), to facilitate fishing business funding and expand market reach in selling catches, as well as driving mining companies to implement Corporate Social Responsibility (CSR) for rehabilitation of coral reefs in adjacent mining zone areas; (3) Optimizing the fishing fleet (ship payload) and

modern fishing gears; and (4) Using information technology in fishing activities.

#### AUTHORS' CONTRIBUTIONS

**Endang Bidayani:** conceptualization, data curation, and methodology; **Yeyen Mardiyani:** conceptualization, writing and data analysis; **Kurniawan, Fahri Setiawan, Siti Aisyah:** spatial analysis and data collecting.

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## **AUTHOR CONTRIBUTION STATEMENT**

We the undersigned, based on mutual understanding and agreement on the contribution proportion to the article that we have written together, with the title:

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Hereby declare that the contribution of each to the writing of the article is as follows:

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2	Endang Bidayani	Main Contributor
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This statement is made truthfully to inform all the interested parties and to be used accordingly.

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