Management Studies and Entrepreneurship Journal
Vol 5(1) 2024 : 1518-1531

Elevating Aquaculture In The East Java Region Through Innovation Strategies Using The TOWS Matrix Approach

Peningkatan Akuakultur Di Wilayah Jawa Timur Melalui Strategi Inovasi Dengan Pendekatan Matriks TOWS

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ABSTRACT
This study investigates innovation strategies for aquaculture in East Java using SWOT analysis and TOWS matrix. Although East Java is one of the three largest contributors in aquaculture in Indonesia, maintaining its sustainability is highly dependent on the right strategy based on environmental conditions. This research used a qualitative method with data collection techniques involving in-depth interviews with 7 informants from various backgrounds. The research findings revealed East Java's strengths in terms of community cohesiveness and adaptability to limitations, but a one-time business cycle due to limited capital and low levels of domestic consumption. Some opportunities still arise, such as East Java's high fisheries export demand and capability and the support of a government program called 'Gemarikan'. On the other hand, its vulnerability to weather, water, budget fluctuations, and poor business practices may pose a threat. As a result, the TOWS Matrix identified several innovation strategies for aquaculture in East Java, namely improving aquaculture literacy and knowledge transfer, community-based improvement, and bottom-up collaborative coordination.
Keywords: *Aquaculture, East Java Region, SWOT Analysis, TOWS Matrix*

ABSTRAK
Penelitian ini menyelidiki strategi inovasi untuk akuakultur di Jawa Timur dengan menggunakan analisis SWOT dan matriks TOWS. Meskipun Jawa Timur adalah salah satu dari tiga kontributor terbesar dalam akuakultur di Indonesia, menjaga keberlanjutannya sangat bergantung pada strategi yang tepat berdasarkan kondisi lingkungan. Penelitian ini menggunakan metode kualitatif dengan teknik pengumpulan data yang melibatkan wawancara mendalam terhadap 7 informan dari berbagai latar belakang. Temuan penelitian mengungkapkan kekuatan Jawa Timur dalam hal kekompakan masyarakat dan adaptabilitas terhadap keterbatasan, tetapi siklus bisnis hanya satu kali akibat terbatasnya modal dan rendahnya tingkat konsumsi domestik. Beberapa peluang masih muncul, seperti permintaan dan kemampuan ekspor perikanan Jawa Timur yang tinggi serta dukungan program oleh pemerintah yang disebut 'Gemarikan'. Di sisi lain, kerentanannya terhadap cuaca, air, fluktuasi anggaran, dan praktik bisnis yang kurang baik dapat menjadi ancaman. Sebagai hasilnya, Matriks TOWS mengidentifikasi beberapa strategi inovasi untuk akuakultur di Jawa Timur, yaitu meningkatkan literasi akuakultur dan transfer pengetahuan, perbaikan *berbasis masyarakat, dan koordinasi kolaboratif dari bawah ke atas.*
Kata Kunci: *Aquaculture, East Java Region, SWOT Analysis, TOWS Matrix*

1. Introduction

Indonesia is a maritime country with two-thirds of the territory consisting of sea. From this geographical advantage, one of the sectors mentioned in SDGs Indonesia Blue Economy is the improvements of fisheries and marine tourism sectors. Measuring the sectors' achievements in Indonesia can be done by analyzing the fisheries sector's Gross Domestic Product (GDP) contribution to Indonesia's GDP. Between 2021 and 2023, the fisheries sector was noted only to

have 3.46% average c-on-c GDP growth - which is higher than the agriculture sector with 1.21% average GDP growth but still lower than the processing industry sector with 3.88% average GDP growth (BPS, 2022)

Based on Scope of Maritime and Fisheries Business Actors, Indonesia's fisheries sectors are divided into several categories of profession as follows: Fisherman (captured fisheries), Aquaculture, Salt Farming, Fisheries Processor, Fisheries Marketer, and Marine and Fisheries Product Delivery Service Provider (Satu Data, 2018). One of the most prominent business actors in the fisheries sector is Aquaculture, which can be seen ranked second, as presented in Table 1 below.

Table 1. Fisheries Categories of the Profession.

Profession	Business Actors	
	KUSUKA Validated	Potential
Fisherman	826.363	2.912.818
Interport Marketer	5.231	4.013
Fish Marketer	54.382	275.458
Aquaculturer	522.368	1.466.681
Fish Processor	76.868	64.239
Salt Farmer	16.527	22.430

Source : Satu Data KKP 2023

Table 2. Indonesia Fisheries Production Volume.

Data Volume Produksi Perikanan Indonesia (Ton)

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SUBSEKTOR	JENIS KEGIATAN	2017	2018	2019	2020	2021	2022*	2023**
TOTAL VOLUME PRODUKSI PERIKANAN (TON)		23.186.443,34	23.049.854,96	22.760.946,74	21.834.105,35	21.872.810,30	24.874.272,04	5.901.073,86
PERIKANAN TANGKAP	TOTAL PERIKANAN TANGKAP	7.071.452,63	7.361.120,91	7.335.322,12	6.989.090,44	7.224.500,59	7.987.701,90	1.898.910,00
PERIKANAN TANGKAP	SUBTOTAL TANGKAP LAUT	6.603.630,52	6.701.834,01	6.630.123,09	6.494.140,38	6.767.564,83	7.412.410,63	1.769.679,00
PERIKANAN TANGKAP	SUBTOTAL TANGKAP PUD	467.822,11	659.286,90	705.199,03	494.950,06	456.935,76	575.291,27	129.231,00
PERIKANAN BUDIDAYA	TOTAL PERIKANAN BUDIDAYA	16.114.990,71	15.688.734,06	15.425.624,63	14.845.014,91	14.648.309,71	16.886.570,14	
PERIKANAN BUDIDAYA	SUBTOTAL BUDIDAYA LAUT	9.884.669,07	9.267.869,28	8.617.168,20	8.499.280,75	7.316.856,35		
PERIKANAN BUDIDAYA	- Budidaya Jaring Apung Laut	76.174,83	22.088,93	16.316,58	12.352,16	28.201,94		
PERIKANAN BUDIDAYA	- Budidaya Laut Lainnya	62.449,57	58.544,27	47.926,83	41.664,34	42.928,61		
PERIKANAN BUDIDAYA	- Budidaya Rumput Laut	9.746.044,67	9.187.236,08	8.552.924,79	8.445.264,25	7.245.725,79		
PERIKANAN BUDIDAYA	Jaring Apung Tawar	353.748,28	398.301,40	467.990,88	442.618,85	432.830,83		
PERIKANAN BUDIDAYA	Jaring Tancap Tawar	25.446,00	54.918,98	40.608,67	23.525,51	23.093,85		
PERIKANAN BUDIDAYA	Karamba	243.728,01	249.919,48	189.414,01	207.455,21	203.739,55		
PERIKANAN BUDIDAYA	Kolam	2.825.894,61	2.546.559,88	2.820.521,28	2.461.357,38	2.726.321,42		
PERIKANAN BUDIDAYA	Minapadi (Sawah)	82.669,94	205.315,53	279.315,46	251.376,88	298.983,39		
PERIKANAN BUDIDAYA	Tambak	2.698.634,79	2.965.849,50	3.010.606,12	2.959.400,34	3.646.484,33		

The fisheries sector shows that aquaculture significantly contributes to the nation's fisheries production volume. From a provincial distribution perspective, the East Java province makes one of the most extensive contributions, as seen in Table 3 below.

Table 3. Regional Aquaculture Total Production.

Province	Volume (tons)
South Sulawesi	4.082.792,15
East Nusa Tenggara	1.397.276,74
East Java	1.279.954,23
West Java	1.233.563,97
Central Java	523.358,00
North Sulawesi	439.139,71

Based on East Java's geographical conditions, its location is deemed suitable for aquaculture cultivation (Zikra et al., 2020). East Java has a sea surface temperature of 28-32^{o}C, supported by comparatively adequate turbidity and water quality, making aquaculture cultivation feasible in its waters. Several studies, as done by Sari et al. (2020) and Anita & Dewi (2020), reveals that aquaculturist in East Java is utilizing these geo-advantages to maximize growth and sustain a level of quality in their aquaculture commodities, such as Asian Seabass

and Cantang Grouper. It is also notable that East Java is the second most populous province, with an estimated 41 million residents, representing a huge potential market for the sale of aquaculture commodities and fisheries products (Sulistyowati et al., 2019).

Analyzing the most current data, the highest Gross Regional Domestic Product contributor in East Java is the processing industry, valuing around 30.56% of the region's total earnings, followed by the commerce sector with 18.94% of East Java's total earnings, and the third rank, agriculture, forestry, and fisheries combined valuing 11.34% of the total revenues (Sulistyowati et al., 2019). Ranking from their respective c-on-c growth, the commerce sector leads with 6.48% growth, followed by the processing industry with 3.95%, and lastly – the second lowest among seventeen business sectors in East Java - agriculture, forestry, and fisheries combined with only 1.8% growth (BPS, 2023). There are many variables to be considered to point to the reasoning for the low growth–low income of the fisheries sector in East Java. Studies done by Lestari et al. (2019) revealed that there has been a favorable expansion in the performance of the fisheries sub-sector in the Minapolitan Area in East Java, with some areas offering a high level of competitive advantage, such as Tuban District. However, research by Ridwan & In'am (2021) regarding the socio-economic conditions of coastal communities in East Java revealed that fishermen tend to live near the poverty line due to their powerlessness as small-scale fishermen. While certain capital providers have offered forms of financial assistance, their contracts are frequently excessively restrictive and inequitable. The absence of well-established altruistic collaboration between capital providers, notably the Fisheries and Marine Affairs Department, and small-scale fishermen has exacerbated the situation, leading to powerlessness due to insufficient working capital or funding. (Ridwan & In'am, 2021). Several research studies have also concluded that fishing villages and fisher families are highly bound to live in poverty due to the lack of funds needed to nurture their small-scale fisheries and structural support from government development programs (Stacey et al., 2021; Susilowati & Mafruhah, 2023). East Java's fisheries need support from both facilitators and government actions to help alleviate poverty. This statement is firmly proven by Rohmah et al. (2023) findings in which by comparing the fisheries sector before and after the execution of the Peti Koin Bermantra program, fisheries actors multiplied their incomes within just six years of receiving assistance.

Several studies conducted SWOT analysis related to fisheries conditions, exemplified by Restuwati & Munif's (2021) and Hakim et al.'s (2022) research on the performance analysis and mentoring strategy of fish farmers' groups and fisheries products processing industry. Another study was carried out by Novianti et al. (2022) on Mangrove Resource and Ecotourism Development, which utilized SWOT analysis. Furthermore, Rizkita et al.'s (2023) and Johan et al. (2023) research on sustainability status analysis and strategy development for the common carp (Cyprinus carpio L.) hatchery industry also involved a SWOT analysis, followed by QSPM. Another study by Wasik & Handriana (2023) underscores the necessity for sustainability strategies in the fisheries industry amid the COVID-19 pandemic, employing SWOT analysis.

2. Literature Review

2.1 SWOT

The easiest way to reveal the current situation and expectations of a sector, an activity, or a company is to perform a SWOT analysis by experts on that subject (Akça, 2005). The term SWOT is an acronym for the first letters of four words in English. These are Strengths, Weaknesses, Opportunities, and Threats (Akça, 2005; İnayet & Akbulak, 2010). SWOT analysis is a technique used to identify the strengths and weaknesses of a sector, an activity, or a firm and identify opportunities and threats from the external environment (Taktak, 2018; Ongun et al.,

2016). Strengths are positive internal aspects controlled, while opportunities are those offered by the external environment that can be used to enhance strengths (and reduce weaknesses). Similarly, weaknesses are negative internal aspects, while threats are external problems or limitations that may hinder the success of the implemented policy (Fertel et al., 2013).

The use of SWOT analysis in fisheries analysis has been widely implemented. SWOT analysis is conducted to decipher the current status of wetlands, understand the reasons for their deterioration and comparatively low fishery productivity, and offer recommendations for their better utilization (Chakraborty et al., 2023). Chakraborty's findings revealed a lack of proper wetland management, declining water quality, insufficient scientific training for fish farmers, and a lack of mass awareness as major concerns. The study provided a rare opportunity for local people to express their perceptions about these issues and, in turn, be part of the decision-making and planning process.

In other studies, the SWOT technique is also used to analyze biosecurity practices on marine fish farms (Muniesa et al., 2022). The SWOT technique was implemented, which identified the critical threats and weaknesses faced by the sector, such as the risk of direct disease transmission between farms, the high likelihood of importing diseases through juvenile shipments, the chronic lack of communication between stakeholders, and the deficient coordination of health strategies. Strengths included awareness of prevention measures and the availability of expertise of health experts at most levels. On the other hand, the availability of experts and the need to adapt governance to the current production systems were seen as opportunities.

Incorporating SWOT analysis goes beyond its application in the realm of fisheries. SWOT analysis is conducted to analyze the organizational aspects such as resources (Novianti et al., 2022), performance, development (Restuwati & Munif, 2021), and strategic planning (De Angelis et al., 2021). SWOT is one of the methods of evaluation used to analyze an organization's internal and external environmental conditions, aiming to formulate strategies to address future uncertainties (Eskafi et al., 2021).

2.2 TOWS

TOWS Matrix is a matrix-based strategy based upon the results of SWOT analysis conditions. The TOWS matrix can be considered a tool to formulate possible strategies based on the identified SWOT results. When internal and external factors are combined, Strengths-Opportunities (SO), Strengths-Threats (ST), Weaknesses-Opportunities (WO), and Weaknesses-Threats (WT) strategies are created (Yontar & Derse, 2023). This analysis is referred to as TOWS (Baker & Edwards, 2012) and is an extension of the SWOT analysis. For the TOWS strategies, SO is a strength that maximizes opportunities; WO is a weakness that is minimized by taking advantage of opportunities; ST is the power that minimizes threats; WT is a strategy in which weaknesses and threats are avoided (Datta, 2020). While SWOT is generally used for planning, TOWS is used for action planning. Therefore, strategies can be developed based on the determined strengths, weaknesses, opportunities, and threats according to the TOWS matrix (Alpar, 2007). These strategies are created by maximizing strengths and opportunities while minimizing the weaknesses and threats of the relevant stakeholders.

The TOWS Matrix is a strategic analysis tool that helps businesses assess, create, compare, and decide business strategies. It is a modified version of the SWOT analysis and stands for Threats, Opportunities, Weaknesses, and Strengths (Chowdhury, 2023; Cuofano, 2023; HARRAPA, 2021). The TOWS Matrix was invented by Heinz Weirich, an American business professor, in 1982 to examine businesses from a practical approach to administration and marketing (Chowdhury, 2023; Mind Tools Content Team, 2022).

The TOWS Matrix is a framework that focuses on external factors affecting the business. It aims to help organizations remain one step ahead in the ever-changing competitive landscape by generating amazing ideas concerning fruitful marketing strategies, decision-making, protection against threats, opportunities, diminishing threats, overcoming weaknesses, and awareness regarding potential shortcomings (Chowdhury, 2023; MBIZ, 2021).

The TOWS Matrix consists of four strategies that help a business understand, plan, and prepare for the possible interaction between threats and weaknesses with strengths and weaknesses. These strategies are laid down in a 2x2 matrix by listing all strengths, weaknesses, threats, and opportunities to develop a TOWS matrix in strategic management (Cuofano, 2023; Professional Academy, 2021).

Here's an example of a TOWS Matrix for Apple (HARRAPA, 2021):

- Strengths-Opportunities (SO): Apple can use its strong brand image to exploit new market opportunities.
- Strengths-Threats (ST): Apple can use its strong financial position to overcome threats such as economic downturns.
- Weaknesses-Opportunities (WO): Apple can overcome its weakness in the cloud services market by investing in new technologies.
- Weaknesses-Threats (WT): Apple can reduce its dependence on a single product line to avoid threats such as supply chain disruptions.

The previous research that utilized a part of TOWS was conducted by Mulyati et al. (2022) regarding the prospects of business development in ornamental fish in Southeast Sulawesi, Indonesia. This research resulted in a business development strategy, with the selected strategy being Strengths and Opportunities (SO). This study only employed strengths and opportunities to formulate innovation strategies in product development. Based on the TOWS framework, four strategy matrices can be applied: SO, WO, ST, and WT. The TOWS matrix is discussed to create potential strategies based on the identified SWOT Analysis strategies. As shown in Figure 1, the combination of internal and external factors leads to the creation of SO, WO, ST, and WT strategies, and their scope is defined in Figure 1.

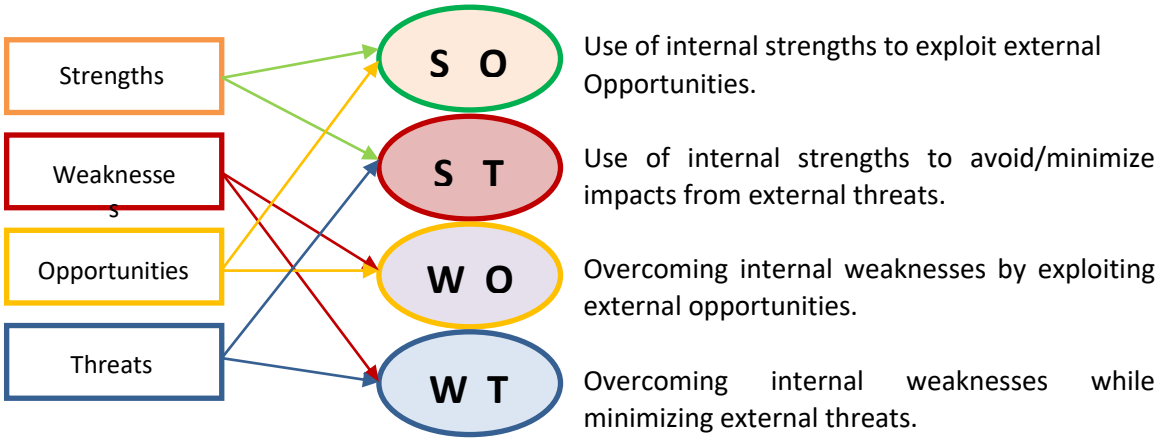

Figure 1. SWOT Structure Illustration

3. Method

This research was conducted in Indonesia from June to September 2023. The research employed a qualitative method, gathering data through focus group discussions and in-depth interviews. The informants for this study came from various backgrounds, including government representatives from the fisheries department, aquaculture practitioners, and fisheries

cultivation experts from academia. The total number of informants in this research was eight individuals. The informant criteria used in this study were a minimum of 5 years of experience in the aquaculture industry and residence in East Java. In addition to using primary data collected through qualitative methods, this research also incorporated secondary data as supplementary information for descriptive analysis. This approach allowed for comprehensive conclusions from both primary and secondary data.

Descriptive data analysis serves as a tool for transforming both primary and secondary data from their raw state into a more understandable format, as highlighted by Martono (2010). This transformation allows for a thorough depiction of the phenomenon under investigation and the potential causal relationships, as emphasized by (Loeb et al., 2017). Additionally, it facilitates the formulation of an assessment of the Sulawesi fisheries sector's current state through a thorough desk study. Subsequently, the outcomes of this analysis are categorized according to the SWOT framework to construct a TOWS analysis.

The research employs a SWOT analysis method, which involves an assessment of the internal and external conditions of the fisheries environment in the East Java region. The analysis undertaken aims to identify the strengths, weaknesses, opportunities, and threats within the aquaculture sector in East Java. This assessment relies on qualitative and secondary data from the fisheries department and the Ministry of Marine Affairs and Fisheries. Subsequently, based on the findings of this analysis, strategic formulation is carried out using the TOWS method. TOWS represents a strategy developed to address weaknesses and challenges by leveraging strengths and capitalizing on existing opportunities.

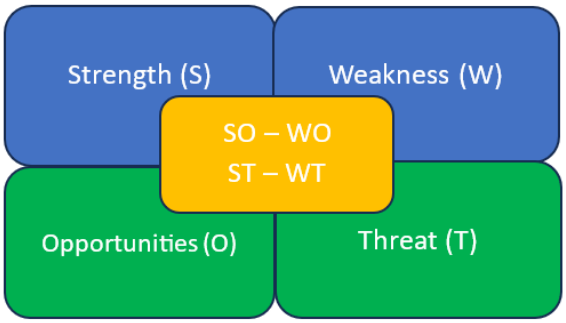

Figure 2. SWOT Framework

4. Results And Discussion

4.1. Strength

Aquaculturists in East Java have a high understanding and problem-solving skills in response to their limitations. A quarter of the East Java population lives near the metropolitan area, which limits the availability of water bodies or even land areas to start an aquaculture business. Aquaculturists consistently seek ways to cultivate aquatic species in denser conditions despite their constraints. They integrate old methods with current technologies to cultivate more fish in tighter ponds, such as aerating with a fresh flow of water from nearby wells, using pumps to help pump water out when it rains or floods, and manufacturing or procuring better food stocks from natural sources.

"There are some development projects for SMEs in the fisheries sector. We even have 'fishing villages' to strengthen the fisheries communities. Management is entrusted to the community, but the government still provides human resource development."

4.2. Weakness

“Mojokerto is one of the smallest cities, you know. We don't have a maritime sector here; we only have the aquaculture sector. The fisheries sector isn't up-and-coming in Mojokerto. Regarding the potential issues in aquaculture, firstly, the land is limited. Why doesn't it thrive? Well, maybe because most fisheries operators here have other primary jobs, they only considered fisheries as a side job or a side gig. So, they're not focused on it. It's different from other cities or districts with larger territories, where more land or space is available.”

"People often receive assistance and are pampered for a while, but it's only for a one-time cycle, and then it's over. This is because the harvest results are sold, but the proceeds aren't reinvested for the sustainability of their cultivation."

For fisheries processing, one of the main weaknesses of its sector is the availability and stability of raw materials. With aquaculturist tendencies to only produce for one cycle, a shift in the supply happens all the time. This forcedly positioned fisheries processors to a highly dependent business because they cannot have their production input necessities and, therefore, can only submit to the suppliers – in this case, fishermen and aquaculturists. Fisheries processors are also burdened by the ever-changing fish qualities whenever they must change their raw materials sources.

"The main raw materials are sometimes hard to come by. We have to go out of town to get them; they are not products produced within the city. We have to purchase them first."

"So when our usual fish supplier is out of stock, finding another place doesn't necessarily guarantee the same quality standards for the fish itself."

“In terms of promotion, there is a lack of a creative team. Social media is still considered insignificant and underdeveloped.”

East Java also has a low domestic fish consumption rate. As can be seen from the figure below, East Java was not included as the most consumptive region when it comes to fish. East Java's fish consumption index was 42.45 Kg/Capita, way below the national fish consumption target of 54 Kg/Capita.

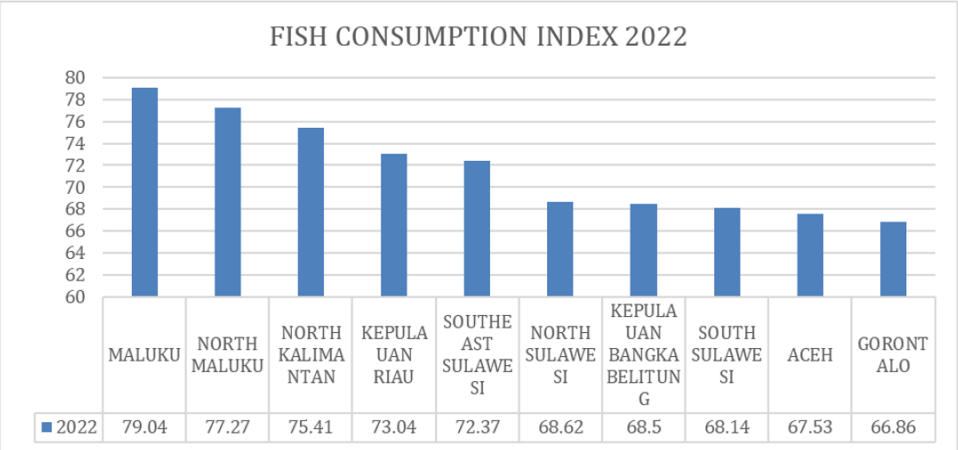

Figure 3. Fish Consumption Index 2022

Source: statistik.kkp.go.id, 2023 (Processed)

In 2019, the East Java government enforced a “Gemarikan“ campaign to boost fisheries consumption among its residents. This campaign has a sole purpose, which is to promote the consumption of fish products, especially in specific regions where stunting and malnutrition often occur. A study by Rowena (2019) reveals that individual and environmental characteristics highly influence Indonesians' purchase intention of fish products, and the Gemarikan program can influence fish consumption. Another study offers a different insight: the likelihood of purchasing and consuming fish products, whether at home or outside, is controlled by one’s

childhood experiences and cooking skills (Maulana, 2021). These findings lead to one conclusion: fish consumption behaviors must be planted slowly but surely, especially to people in East Java.

4.3. Opportunities

In 2022, captured fisheries in East Java produced 551.846 tons of fish, while aquaculture earned 1.3 million tons, making East Java the highest aquaculture producer in the Java Region. East Java was also recorded as the highest national fisheries exporter in volume and earnings, with 381.477 tons and export earnings as high as 2.6 million USD (Jatim Newsroom, 2023). This proves the high demand for exports that East Java can provide.

"The potential for fisheries in East Java is quite significant, but perhaps the local community sometimes underestimates it. I believe it's enormous if one is willing to get deeply involved. As for sales efforts, there have not been any obstacles up to now. We have more demand than we can handle. Some orders are even a bit late; new batches of fish are currently being restocked."

In the third quarter of 2022, East Java governor Khofifah Indar Parawansa authorized the sales of 25 tons of frozen Red Snapper to the Dominican Republic and 25 tons of frozen processed shrimp to Japan (Jatim Newsroom, 2022). At the same time, Khofifah mentioned that East Java will continue strengthening its competitiveness in 2023 by supporting export efforts and stabilizing supply. Concluding from these events, East Java already has its respective export demands. To speed up East Java's economic recovery due to the COVID-19 pandemic, fisheries export might be the solution that brings an answer.

4.4. Threats

4.4.1. Weather and Water Availability.

The most significant challenge for aquaculturists continues to be the ongoing issues of global warming and the unpredictable patterns of freshwater. Due to a lack of financial resources for investing in advanced technologies, aquaculturists have limited capacity to prepare for weather fluctuations. Managing water temperatures during heat waves can be achieved by introducing fresh water into fishponds, while water pumps can help regulate water levels during periods of heavy rainfall or floods. However, the dilemma arises during droughts when water availability becomes scarce.

"*The weather remains the biggest deciding factor whether we will yield profits or losses. If we face heavy rains or storms, we can still manage our ponds' water level to remain steady. But the dry season, on the other hand, is the biggest problem. If we don't have access to water, we can't maintain water circulation, which will often lead to deaths in our ponds."*

Some aquaculturists have used supplementary technologies such as aerators and bubble machines to help water circulate. However, compared with its impact, the cost of investment and operating said machines needed to meet expectations. Aerators and bubble machines are considered stationed machines, meaning they can only supply oxygen to specific areas within the pond rather than distribute it evenly, resulting in inadequate oxygen saturation throughout the entire pond (Abdelrahman & Boyd, 2018; Baldwin et al., 2022). Another issue arises when aquaculturists manage large ponds, requiring more powerful aerators to meet their oxygenation needs. Unanimously, aquaculturists preferred a steady flow of fresh water to provide oxygen circulation rather than depending solely on machineries.

"In the early days, we did use aerators to provide oxygen and circulation. However, it has proven to be not enough. The water will become cloudy and dirty sooner or later due to the lack of new water circulation. Therefore, we concluded that circulation is more important than just using aerators."

4.4.2. Budget Tightening.

Although East Java's fisheries industry is deemed promising when judged by previous accomplishments, the opposite can be said for its fisheries budgets. Several officials from the subregional Marine and Fisheries Agency have noted that the funding available for supporting aquaculturists is limited and can only assist some selected groups. East Java has initiated specific programs aimed at achieving food self-sufficiency by 2023, aligning with the seven key priorities outlined in the Regional Government Work Plan for East Java (Jatim Newsroom, 2023). However, suppose the potential of aquacultures is not adequately promoted and communicated. In that case, there is a risk that other sectors, such as agriculture and plantations, may receive a more substantial portion of the budget allocation, potentially diverting resources from the crucial fisheries and aquaculture needs.

"*From the government's perspective, the budget is currently tight. Many projects cannot be continued due to limited funding. The hope is for a larger budget to be distributed to the community.*"

4.5. Innovation Strategies

The innovation strategy for the aquaculture sector can be divided into three aspects: education, marketing, and collaborative coordination. Here are the strategies created within the SO, ST, WO, and WT scope, produced by crossing internal and external factors in the TOWS Matrix.

Table 4. TOWS Matrix

	Strength - High level of understanding & problem solving accompanied with adaptivity towards technology - Strong bond within local aquaculturist communities	**Weakness** - Not enough working capital leads to one-time cycle production - Low domestic consumption rate - Availability and stability of production
Opportunity - High demand for export - Existing government projects (Gemarikan, 2023 food self-sufficiency program)	**SO Strategy** - Share/distribute information or technologies that have proven to be rewarding and applicable for aquaculturists - Increase fish production	**WO Strategy** - Build communal brands to fulfill export demand - Marketing efforts to boost knowledge transfer about fish products
Threat - Weather and water unavailability - Budget tightening for the fisheries industry - Substandard business practices	**ST Strategy** - Coordinate with water supply services and urban planning agencies - Cater to local fisheries communities and plan a budget through bottom-up coordination	**WT Strategy** - Allocate a higher budget to help reduce one-time cycles - Educate on business models

4.5.1 Educational Aspects.

Certain aquaculturists in East Java have demonstrated remarkable problem-solving abilities and resourcefulness, utilizing cost-effective yet efficient approaches to enhance fisheries production and increase profitability, such as using pumps and machineries or producing their type of fish feeds. However, this knowledge may not be widely spread or

accessible within specific communities or locations. To increase aquaculturist's fisheries literacy is to increase productivity and business resilience (Benard et al., 2020).

Conversely, most aquaculturists also need more economic and financial literacy, hence their low-bargaining power in the face of buyers and distributors. Small-scale aquaculturists may find themselves powerless during negotiation and transaction, which increases the chance of fraud, failure to receive funds, financial losses, and bankruptcy among aquaculturists (Bjørndal et al., 2015). An economic educational program is deemed favorable to increase the bargaining power of said aquaculturists (Sumbodo et al., 2021). Aquaculturists must enhance their financial standing within the business supply chain, and the most effective means to attain such leverage is acquiring financial literacy. The aim is to elevate the perceived value of aquaculturists and eliminate any underestimation by buyers and distributors.

4.5.2 Marketing Aspects.

To address the needs of small-scale aquaculturists, establishing a communal brand that allows everyone to contribute and receive earnings commensurate with their contributions could serve as a pivotal solution to eradicate economic inequality within the aquaculture sector. This approach encourages aquaculturists to forge alliances and work collectively to meet specific production targets – which aligns with the Strength matrix that East Java's aquaculturists have.

A comprehensive marketing campaign to enhance local fisheries consumption remains imperative. The Marine and Fisheries Agency must ensure a significant increase in fish consumption rates shortly. Boosting the local fisheries consumption rate implies strengthening reliance on aquaculturists, enabling them to maintain a consistent revenue stream. Consistent revenue will ultimately reduce the dependence on the government's financial aid and minimize the occurrence of one-time cycles among aquaculturists.

4.5.3 Collaborative Coordination Aspects.

The aquaculture sector urgently requires a significant boost. By providing essential working capital funds, the government of East Java has the potential to alleviate poverty and enhance productivity within the aquaculture industry and other fisheries sectors. Government assistance frequently aligns differently with the specific needs or preferences of the business actors. Therefore, bottom-up coordination is highly preferable to relinquish the needs of East Java's aquaculturists. Numerous studies conducted in various regions have come to a shared conclusion: adopting a bottom-up coordination strategy holds the potential to drive significant progress within the fisheries sector (Aburto et al., 2017; Alexander et al., 2020). This approach prioritizes the input and experiences of individuals at the industry's bottom level. Doing so ensures that those who often face the most challenging issues are heard and actively engaged in shaping practical solutions (Andriesse et al., 2021; Ballarini et al., 2021). This strategy recognizes the importance of empowering and involving all stakeholders, especially those with first-hand experiences of the sector's challenges, to chart a sustainable and effective path forward for the fisheries industry.

Therefore, prioritizing a bottom-up approach is strongly recommended to cater to the unique needs of East Java's aquaculturists. East Java can establish a strategic coordination platform, empowering aquaculturists to communicate their most pressing needs and challenges directly to the Marine and Fisheries Agency. This approach ensures that assistance and policies are better tailored to the real-world concerns and aspirations of those in the aquaculture industry.

5. Conclusion

The analysis conducted in East Java employed the TOWS approach, focusing on threats, opportunities, weaknesses, and strengths. The environmental analysis revealed several key findings: strengths include an elevated level of problem-solving abilities, technological **ADAPTABILITY**, and strong community bonds among local aquaculturists. Weaknesses include insufficient working capital leading to one-time cycle production, a low domestic consumption rate, and challenges in production availability and stability. Opportunities include high export demand and government projects like the 2023 food self-sufficiency program (Gemarikan), while threats encompass issues such as weather-related challenges, water availability, budget constraints in the fisheries industry, and substandard business practices. This research complements previous work by Aburto et al. (2017), Alexander et al. (2020); Andriesse et al. (2021), and Ballarini et al. (2021). The strategies employed involve increasing fish production using technology, building communal brands and marketing to expand internationally, collaborating with water supply and fishery agencies to enhance production quality and quantity, and allocating budgets while educating stakeholders on aquaculture business models. The study holds significance for both theoretical and practical implications. Theoretical implications include contributing to understanding the TOWS concept within the aquaculture context, combining elements of business management and agribusiness industrialization. In the professional realm, it provides a foundation for policymakers and practitioners to make informed decisions related to the aquaculture business environment. As with any research, there are limitations. This study exclusively employed TOWS analysis and did not proceed with a positional analysis based on the IFAS approach. So, future research could potentially generate more effective, comprehensive, and innovative strategies focused on internal factors for aquaculturists, through the combination of TOWS and IFAS methodologies (Adi Wibbowo, 2022).

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