

Strategy for improving the quality of landed mackerel fish at the Tawang Coastal Fishing Port of Kendal Regency, Indonesia

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Abstract. Mackerel stands out as a prominent fisheries commodity in Indonesia, particularly in Kendal Regency. The effective handling of fish emerges as a pivotal factor influencing the success of capture fisheries, as any decline in fish quality translates into substantial economic losses. This study aims to formulate a comprehensive strategy for enhancing the quality of landed mackerel at the Kendal Regency Coastal Fishing Port. The data analysis was conducted through a descriptive quantitative approach, while strategy development employed both SWOT analysis and the TOWS matrix. The findings unequivocally demonstrate the necessity for various strategies to elevate the quality of mackerel landed at the Kendal Regency Coastal Fishing Port. These include: the advancement of the mackerel fish industry (SO Strategy), the implementation of suitable cold chain system technology (WO Strategy), the establishment of quality standards for mackerel fish commodities (ST Strategy), and the fostering of competence among fishermen and fish traders (WT Strategy). The strategic priority, as indicated by the research, lies in the SO strategy.

Key Words: Kendal Regency, mackerel, quality, SWOT analysis, TOWS matrix.

Introduction. Mackerel (*Rastrelliger* sp.) is a small pelagic fish that is highly hunted by fishermen in several regions in Indonesia. Indonesia is the home of various types of mackerel, including: *R. kanagurta* (Indian mackerel), *R. brachysoma* (short mackerel), and *R. faughni* (island mackerel). Inhabiting the epipelagic zone, mackerel sustains itself with a diet comprising phytoplankton, zooplankton, and various larvae, including those of fish and shrimp (Collette & Nauen 1983; Nontji 2005; Ganga 2010). The selling price of mackerel is monitored by Indonesian government, with an average price of IDR 33,355 per kg in 2021 (KKP 2022).

Kendal Regency is a regency in the northern coast of Java Island. There are five fishing bases in the regency, where the Coastal Fishing Port of Tawang is the largest one. Kendal Regency lies between 109°40'–110°18' East longitude and 6°32'–7°24' South latitude. The region boasts a fishing community of 1,689 individuals utilizing a fleet comprising 152 outboard motor boats and 1,892 motorboats. In 2021, the marine fisheries production in Kendal Regency totaled 3,921 tons, encompassing mackerel (BPS-Statistics of Kendal Regency 2022). The vitality of fish handling cannot be overstated in the success of capture fisheries, as a decline in fish quality incurs substantial economic losses, particularly concerning mackerel. Given the perishable nature of fish, preventing post-harvest losses emerges as a critical factor for the sustainable development of the fishing industry (Afifah et al 2023). This study aims to develop a comprehensive strategy for enhancing the quality of landed mackerel in Kendal Regency, notably at the Tawang Coastal Fishing Port. The formulated strategy also takes into account external and internal environmental conditions.

Material and Method

Research location. This research was carried out at Tawang Coastal Fishing Port, Kendal Regency (Figure 1)

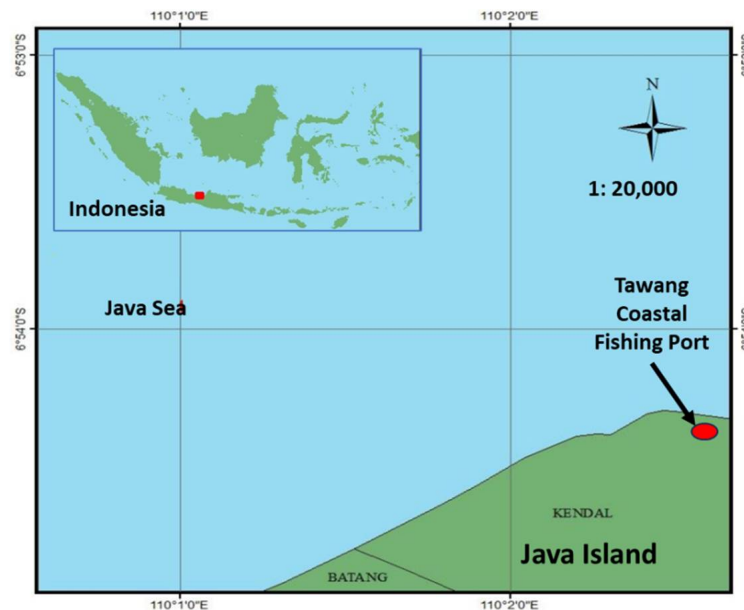


Figure 1. Tawang Coastal Fishing Port map.

Data source. Research data were obtained from the Marine and Fisheries Service of Kendal Regency, Statistics of Kendal Regency, as well as the results of surveys, discussions with key informants and interviews. Interviews were conducted with 20 respondents consisting of fishermen, fish traders, bureaucrats and academics.

Data analysis. The data of this research underwent descriptive quantitative analysis. Strategy development was performed using SWOT analysis and TOWS matrix. SWOT analysis has been widely used by managers and policy makers in formulating strategies. Several researchers also used this method, including Oreski (2012), Viegas et al (2014), Wijayanto (2016), Furqan et al (2017) and Kurohman et al (2020).

Results. Mackerel fish is highly nutritious and it is a good source of omega-3 and omega-6 fatty acids - essential polyunsaturated fatty acids (PUFA) that strengthen the heart muscle endurance, improve the brain intelligence, reduce the triglyceride levels and prevent blood clots. Fish protein contain complete non-essential and essential amino acids (Marichamy et al 2009; Afifah et al 2023).

SWOT analysis and TOWS matrix. Tawang Coastal Fishing Port is the largest fishing port in Kendal Regency. The fishing boats at Tawang Coastal Fishing Port are larger in size compared to the ones in other Fishing Ports such as Sendang Sikucing, Tanggul Malang, Bandengan and Karang Sari that are operated by traditional fishermen. Meanwhile, Tawang Coastal Fishing Port can facilitate bigger vessels over 20 GT in capacity. Fishermen at Tawang Coastal Fishing Port use various types of fishing gears: mini purse seine, gill net, trammel net, trap, and line. Mackerel fish are caught with a mini purse seine. Tawang Coastal Fishing Port has 18 outboard motorboats and 800 motorboats (BPS-Statistics of Kendal Regency 2022).

MMF Regulation no 7/2019 regulates the quality control of fishing vessels. Indonesian government has also established SNI No. 01-2729.1-2006 concerning fresh fish specifications. Despite these regulatory frameworks, practical implementation reveals deviations from the stipulated quality standards outlined in MMF Regulation no 7/2019. There has been a lack of government-established standardization for the quality of mackerel.

Tawang Coastal Fishing Port has been designed to cater to the essential needs of fishermen and fish traders, providing a range of facilities for the landing and distribution

of fish. Among these amenities are breakwater facilities, shipping lanes, docks, fish auction areas, electrical installations, clean water installations, fuel stations, ice factories, beacon towers, safety signs in the estuary, fish stalls, and various other public facilities. Despite these resources, there remains a need for improvement in the management of fish landing facilities and fish marketing. Some fishermen and fish traders demand fish handling trainings from the government.

The observations done in this research revealed wrong practices in handling mackerel fish, where fish was often exposed to direct sunlight and suboptimal cleanliness of work tools. However, from a market perspective, the demand for mackerel remains relatively high. Mackerel is not only sold in local markets but is also exported to countries such as Thailand. The global market for mackerel encompasses various forms, including fresh, frozen, smoked, canned, and salted fish. Notably, Japan, Chile, China, India, and Russia stand out as the primary global producers of mackerel (Tridge 2020). Mackerel production in Tawang Coastal Fishing in 2021 reached 49,099 kg, while overall production in Kendal Regency was 89,897 kg (DKP of Kendal Regency 2022).

The technology of cold chain systems has advanced significantly, with numerous fish processing companies adopting these systems globally, including in Indonesia. There is a pressing need for fisheries businesses in Kendal Regency to leverage the advancements in cold chain system technology. Tawang Coastal Fishing Port is equipped with an ice factory that produces products capable of effectively cooling fish, thereby preventing rapid decay. The matter of food safety is gaining heightened focus from stakeholders, particularly concerning mackerel fish products.

Considering the information provided, the outcomes of the SWOT analysis are detailed in Table 1. The scores associated with strengths, weaknesses, opportunities, and threats reveal that the prioritized strategy is the S-O (Strengths-Opportunities) strategy. The results of the TOWS matrix are presented in Table 2.

Table 1

SWOT analysis

No	Key factors	Weight	Rating	Score
<i>Strength</i>				
1.	Large production of mackerel fish obtained by fisherman and fish traders.	0.151	3	0.453
2.	Fishermen catching mackerel use environmentally friendly fishing gear and can produce good quality fish.	0.168	4	0.672
3.	Fishermen have sufficient fish storage.	0.155	3	0.465
4.	There are regulations that require quality and safety guarantees for fishery products.	0.302	3	0.906
5.	There are adequate fish landing and fish marketing facilities.	0.224	3	0.672
Total		1.000		3.168
<i>Weakness</i>				
1.	Lack of outreach and training on fish handling standards.	0.225	3	0.675
2.	No specific standards applied for the handling of mackerel.	0.202	3	0.606
3.	Fish marketing facility management still needs to be improved.	0.166	3	0.498
4.	Enhancement in the knowledge about fish quality among fishermen and fish traders is needed.	0.213	3	0.639
5.	Improper fish handling still occurred.	0.194	3	0.582
Total		1.000		3.000
<i>Opportunity</i>				
1.	Mackerel production is still high.	0.243	4	0.972
2.	Demand for mackerel fish is quite high.	0.194	3	0.582
3.	Cold chain system technology is available.	0.213	3	0.639
4.	Ice factory and warehouse are available at Tawang Coastal Fishing Port.	0.173	3	0.519
5.	Research institutions and universities can provide support for the improvement of fish quality through research and training.	0.177	3	0.531
Total		1.000		3.243

<i>Threat</i>				
1.	The international market demands high quality products.	0.191	3	0.573
2.	Consumer awareness regarding the importance of fish quality is increasing.	0.213	3	0.639
3.	National fish trading competition.	0.147	4	0.588
4.	International fish trade competition.	0.224	3	0.672
5.	Food safety issues should be addressed.	0.225	3	0.675
Total		1.000		3.147

Table 2

TOWS matrix

	<i>S (1 to 5)</i>	<i>W (1 to 5)</i>
O (1 to 5)	SO Strategy: Development of the mackerel industry with emphasis on fish quality (S1, S2, S3, S4, S5, O1, O2, O3, O4)	WO Strategy: Application of appropriate technology in the cold chain system (W3, W4, W5, O1, O2, O3, O4, O5)
T (1 to 5)	ST Strategy: Determination of quality standards for mackerel fish commodities (S3, S4, T1, T2, T3, T4, T5)	WT Strategy: Developing the competence of fishermen and fish traders through training, counseling, and mentoring (W1, W2, W3, W4, W5, T1, T2, T3, T4, T5)

The comprehensive development of the fisheries industry, encompassing mackerel fish commodities, requires a holistic approach from upstream to downstream. Port facilities, particularly in terms of management, need substantial enhancements to meet stringent hygienic and sanitation standards. Addressing the supply needs of fishermen involves the strategic attraction of investors to establish supply shops, equipment outlets, ice factories, cold storage facilities, and fish processing factories.

Appropriate technology in the cold chain system is necessary in maintaining the quality of mackerel. This involves using refrigeration rooms for industrial ships or employing preservatives like ice and salt. Cold chain practices, encompassing unloading at ports, fish auctioning, and mackerel distribution, should be rigorously maintained, utilizing ice or refrigerated facilities. Maintaining cleanliness standards for both fish and equipment is paramount. Establishing quality standards for mackerel involves collaboration with experts and practitioners, serving as essential references for ensuring food safety and enhancing market value. The competence of fishermen and fish traders can be elevated through training, counseling, and mentoring initiatives, facilitated through collaboration with the government, experts, extension workers, and NGOs.

Discussion. The discussion highlights the need to boost Kendal Regency's economic growth, with a focus on the marine fisheries sector, which holds substantial potential. The small pelagic fish resources, including mackerel in the Java Sea, have room for increased production according to MMF Decree No 19/2022. Despite the regency's GRDP reaching Rp 42 trillion in 2020, with the agricultural sector (including fisheries) as the second-largest contributor, there is untapped potential for growth (BPS-Statistics of Kendal Regency 2022). To optimize the contribution of mackerel fisheries to economic development and employment, a strategic approach involves prioritizing fish quality, incorporating suitable technology for cold chain systems, establishing quality standards for mackerel commodities, and enhancing the competencies of fishermen and fish traders through training, counseling, and mentoring. The synergistic implementation of these four strategies is essential for the comprehensive development of the mackerel fish industry, ensuring its positive impact on economic growth and employment in Kendal Regency.

The primary fishing grounds for fishermen in Kendal Regency are located in the Java Sea, a region renowned for its complexity within the Indonesian waters. This complexity is attributed, in part, to the sheer number of fishermen operating in the area and the diverse array of fishing gear employed. The multitude of fishing gear types and fish resources amplifies the intricacies of fisheries management. The interactions between various fishing gear types and different species often lead to negative externalities, as noted by Wijayanto et al (2020). In the context of multi-species fisheries, fishing strategies undergo changes depending on the target fish, and the selection of target fish is further influenced by the stock levels of each species (Sadiyah & Prisantoso 2011).

The fish auction facility at Tawang Coastal Fishing Port holds significant potential as a marketing center with a focus on quality management, particularly for mackerel. As emphasized by Kurohman et al (2020), ensuring the optimal functioning of fish auction places requires a combination of formal and informal approaches, taking into account social and cultural aspects. According to Solihin et al (2016), fishing ports, including fish auction places, play a crucial role in fisheries development, serving as both the foundation for fishing activities and a means of stimulating the economy through catch marketing. The development of the mackerel fish processing industry holds particular importance in elevating the product's added value. A thriving fish processing industry not only generates employment opportunities but also serves as a catalyst for economic growth. The symbiotic relationship between capture fisheries and the fish processing industry is underscored by Silovs (2018) and Kurohman et al (2020), emphasizing that the integration of these two components is integral to the successful development of the fisheries industry.

The training, counseling, and empowerment of fishermen and fish traders play a pivotal role in enhancing the competency of fisheries business actors and ensuring the quality maintenance of mackerel fish. As highlighted by Atukunda et al (2018), fisheries extension emerges as a critical factor in facilitating social change within this context. Empowering coastal communities can be effectively undertaken through collaborative efforts involving extension workers, academics, non-governmental organizations (NGOs), and community leaders. The synergy between these stakeholders is essential for the success of empowerment initiatives. Murshed-e-Jahan (2014) underscores the effectiveness of communication among fishermen in addressing conflict resolution.

A cold chain system needs to be applied to maintain the quality of mackerel. Wibowo et al (2014) reveal that utilizing a low temperature of 0°C post-mortem can extend the rigor mortis phase, reduce enzymatic, bacterial, and chemical activity, and minimize physical changes in the fish. Insufficient ice on the fish poses a risk of inadequate cooling, leading to increased microbial activity and fish spoilage, as highlighted by Junianto (2003). The decline in the quality of mackerel fish can lower the post-harvest fishery yields. Post-harvest losses are the total value of post-harvest losses from fishery products that occur due to damage to fish, including physical damages, quality damages and other damages that occur during the process. Yield losses include namely physical losses, quality losses and financial losses.

Conclusions. The research findings affirm that enhancing the quality of mackerel fish at the Tawang Coastal Fishing Port requires a multifaceted approach; development of the mackerel fish industry (SO strategy), implementation of appropriate cold chain system technology (WO Strategy), establishment of quality standards for mackerel fish commodities (ST Strategy), as well as developing the competence of fishermen and fish traders (WT Strategy) with strategic priorities being the SO strategy.

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Conflict of interest. The authors declare that there is no conflict of interest.

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