

SUSTAINABLE MARKETING AND DISTRIBUTION STRATEGIES IN THE SEAWEED INDUSTRY FOR COMPETITIVE MSMES: A SYNERGISTIC APPROACH

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Abstract

How to cite this paper: Erwin, Arbit, N. I. S., & Ridwan, R. A. (2025). Sustainable marketing and distribution strategies in the seaweed industry for competitive MSMES: A synergistic approach. *Corporate and Business Strategy Review*, 6(4), 87–95.
<https://doi.org/10.22495/cbsrv6i4art8>

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ISSN Online: 2708-4965

ISSN Print: 2708-9924

Received: 23.10.2024

Revised: 05.02.2025; 06.10.2025

Accepted: 24.10.2025

JEL Classification: Q13, M31, O13

DOI: 10.22495/cbsrv6i4art8

This study explores the potential of the seaweed industry in a developing country and aims to develop sustainable marketing and distribution strategies to enhance competitiveness. Despite facing challenges such as limited public awareness of seaweed products, recent advancements in cultivation methods and cross-sector collaborations highlight significant growth opportunities (Tabrani et al., 2024). Utilizing literature reviews, in-depth interviews, and comparative studies, the research identifies the strategic role of the Seaweed Cultivation Center in bridging profit and non-profit sectors. Non-profit initiatives include technological innovation and environmental sustainability efforts, while profit-driven activities focus on efficient production, storage, and marketing through collaborations among cultivators, processors, and the warehouse receipt system. The findings demonstrate that integrating these sectors can enhance product competitiveness and expand market reach, benefiting local micro, small, and medium enterprises (MSMEs) in developing countries and fostering economic growth. The study underscores the necessity of effective marketing communication strategies and a sustainable distribution system, emphasizing their role in increasing product value and supporting community welfare within the seaweed industry in developing contexts.

Keywords: Seaweed Industry, Sustainable Marketing, Distribution Strategies, Developing Country, Micro, Small, and Medium Enterprises (MSMEs)

Authors' individual contribution: Conceptualization — E., N.I.S.A., and R.A.R.; Methodology — E., N.I.S.A., and R.A.R.; Software — E., N.I.S.A., and R.A.R.; Validation — E., N.I.S.A., and R.A.R.; Formal Analysis — E., N.I.S.A., and R.A.R.; Investigation — E., N.I.S.A., and R.A.R.; Resources — E., N.I.S.A., and R.A.R.; Data Curation — E., N.I.S.A., and R.A.R.; Writing — E., N.I.S.A., and R.A.R.

Declaration of conflicting interests: The Authors declare that there is no conflict of interest.

1. INTRODUCTION

Seaweed is a macroscopic alga that lives on the coast or shallow sea waters. Seaweed can be cultivated by planting seaweed in waters manually, the results of cultivation can provide benefits in several aspects, such as economic, social, and environmental in particular because it is an environmentally friendly product that can be decomposed by microorganisms, and can be renewed (Yustinah et al., 2019). Based on data from the Ministry of Maritime Affairs and Fisheries, seaweed production in Indonesia reached 9.12 million tons with a value of 28.48 trillion of Indonesian Rupiahs in 2021. Indonesia is one of the largest seaweed producers in the world. This is considering that most of Indonesia's territory is sea which is the location of the source of this commodity. Data from the Ministry of Maritime Affairs and Fisheries shows that Indonesia's seaweed production reached 9.12 million tons in 2021.

As a developing province, West Sulawesi also plays a role in producing seaweed, in 2021 amounting to 77,27 tons, although its production is not as large as South Sulawesi province, this production can be increased, considering that seaweed cultivation locations have been found in the waters of Majene regency in each sub-district that meet the criteria for water conditions in seaweed cultivation, this is based on the results of research by researchers, in collaboration with the Conservation Strategy Fund in 2023 (Arbit et al., 2023).

The findings have increased the number of districts in West Sulawesi province that are suitable for cultivation, which were previously dominated by Mamuju and Polewali Mandar districts. Based on the number and expectations of increasing production, the development of an integrated seaweed cultivation industry can be a great hope for micro, small, and medium enterprises (MSMEs), although several problems were found in the management of the seaweed industry, such as limited public knowledge of products, especially seaweed cultivation products to attract buying interest (Erwin & Muthmainnah, 2023). This research introduces a novel approach to sustainable marketing and distribution strategies within the seaweed industry, specifically targeting competitive MSMEs in West Sulawesi. While previous studies, such as those by Tabrani et al. (2024) and Spillias et al. (2022), highlight the challenges and opportunities within the seaweed sector, this study uniquely integrates an ecosystem-based model that fosters collaboration among cultivators, processors, and local governments. By positioning the Seaweed Cultivation Center as a central hub, the research builds on Blikra et al. (2021), who advocate for leveraging technological innovations, while also addressing the logistical inefficiencies identified by Zamroni and Yamao (2012). Moreover, this study aligns with the triple P perspective of van den Burg et al. (2021), emphasizing the interconnectedness of profit, people, and planet in developing a sustainable value chain. Additionally, it expands on the frameworks proposed by Mac Monagail et al. (2017) and Wale et al. (2022) by focusing not only on sustainability but also on the operational aspects of marketing and distribution, thereby filling a crucial gap in the existing literature. This focus on integrated, actionable strategies positions the study as a pioneering contribution to the ongoing

discourse on sustainable development in the seaweed industry, offering new insights for future research and practice.

This study attempts to use significant factors in increasing competitiveness through the implementation of sustainable communication and distribution strategies in the integrated seaweed cultivation industry through the MSME sector. Several previous research results are used as the basis for the opportunity to develop the seaweed industry in the MSME sector in West Sulawesi province, from these opportunities in maturing other basic needs, the researcher also conducted a problem-solving approach by means of in-depth interviews with cultivators and MSME actors related to the needs in developing an integrated cultivation industry.

This research significantly contributes to the understanding of the seaweed industry in West Sulawesi by identifying factors that enhance the competitiveness of MSMEs within this sector. By expanding the knowledge of suitable districts for seaweed cultivation, the study provides a strategic framework for regional development and investment. It also introduces sustainable marketing and distribution strategies tailored to local needs, facilitating collaboration between profit-driven and non-profit initiatives. Additionally, the use of in-depth interviews with stakeholders offers valuable insights into the challenges and opportunities faced by cultivators and MSMEs, enriching the existing literature with practical perspectives.

The paper is structured into six key sections. Section 1 outlines the significance of the seaweed industry in West Sulawesi and the research objectives related to enhancing the competitiveness of MSMEs through sustainable marketing and distribution strategies. Section 2 examines existing studies on sustainable practices in the seaweed sector and identifying gaps that this research aims to address. Section 3 details the qualitative approach used, including in-depth interviews with stakeholders to gather insights into industry challenges and opportunities. Section 4 presents the key findings, emphasizing factors that enhance competitiveness and stakeholder perspectives. Section 5 interprets the results within the context of the existing literature and explores their implications for the industry. Finally, Section 6 summarizes the main findings and offers recommendations for future research and practices to support local economic growth and sustainability in the seaweed industry.

2. LITERATURE REVIEW

Seaweeds are increasingly recognized globally as a valuable resource with potential applications in diverse sectors, particularly in Europe, where efforts are underway to integrate them into food, cosmetic, pharmaceutical, and industrial supply chains (Blikra et al., 2021). However, their widespread adoption faces significant challenges such as food safety concerns, quality preservation issues, and consumer acceptance barriers, reflecting the need for sustainable practices in seaweed farming and industry development to overcome these obstacles. The global momentum towards sustainable seaweed utilization is exemplified by initiatives in Sweden, where projects like the Seafarm initiative explore holistic biorefinery approaches (Thomas, 2018). These initiatives not only assess the viability and environmental impacts of seaweed cultivation but

also evaluate economic potentials and scalability, emphasizing sustainable development strategies essential for industry maturation and integration into broader economic systems. Furthermore, in Europe, seaweeds are increasingly seen as crucial for advancing towards circular food systems and bio-based economies (van den Burg et al., 2021). Emphasizing quality over quantity and aligning with circular economy principles, European efforts aim to integrate seaweeds into food systems while addressing sustainability challenges. This approach underscores the importance of nature-inclusive production systems and sustainable practices to maximize the benefits of seaweed farming while minimizing environmental impacts.

As seaweed farming expands globally, particularly in large-scale aquaculture settings, sustainability considerations become paramount (Spillias et al., 2022). While seaweed farming offers opportunities to contribute positively to sustainability goals such as zero hunger, sustainable production, and ecosystem preservation, careful management is essential to mitigate potential adverse impacts on marine ecosystems. Regulatory frameworks and sustainable farming practices are critical in realizing the full potential of seaweed as a sustainable biomass and economic resource. In Indonesia, the seaweed agro-industry presents promising opportunities due to the country's abundant natural resources and species diversity (Tabrani et al., 2024). Despite this potential, challenges like complex licensing, limited technology adoption, and inadequate marketing strategies hinder sustainable growth. Addressing these challenges requires comprehensive management approaches focusing on stakeholder engagement, sustainable resource management, technological innovation, and effective market strategies.

Seaweed farming has historically supported coastal economies, as seen in Indonesia where small-scale operations in Laikang Bay contribute significantly to local livelihoods (Zamroni & Yamao, 2012). Middlemen play a pivotal role in supporting seaweed farmers by providing capital and facilitating market access, underscoring the importance of sustainable economic practices within the industry. In Bangladesh, the nascent seaweed industry demonstrates economic promise, particularly along the southeast coast where farming methods like long-line and horizontal net systems are economically viable (Ahmed et al., 2022). However, challenges such as inadequate credit availability and the absence of robust value chains hinder industry expansion. Sustainable development requires addressing these challenges through improved market infrastructure, technological innovation, and community engagement to foster a resilient and inclusive industry.

Globally, the utilization of seaweeds extends beyond traditional uses to include hydrocolloids, biofertilizers, bioplastics, and renewable energy sources (Yong et al., 2024). This diversification highlights seaweeds' potential in advancing sustainable practices across various sectors. However, sustainable management is imperative to prevent over-exploitation and environmental degradation, as emphasized by efforts to standardize cultivation techniques and ensure traceability of products (Hafting et al., 2015). The evolution of the seaweed industry underscores its role in global sustainable development, with initiatives focusing on economic growth, environmental

stewardship, and community resilience. Integrating seaweed into circular economy models and enhancing value chains are critical steps towards realizing its full potential as a renewable and multifunctional resource (Mac Monagail et al., 2017; Wale et al., 2022).

However, the seaweed industry, particularly in regions like Indonesia and Malaysia, faces significant supply chain risks that impact distribution strategies. Mulyati and Geldermann (2017) emphasize that uncertainties in yield, quality, price, and infrastructure can disrupt the entire supply chain, necessitating a robust supply chain risk management (SCRM) framework. Their study outlines critical SCRM steps: identifying supply chains, categorizing risks, assessing risks through interviews, and mitigating those risks with sustainability in mind. Similarly, Nor et al. (2020) conducted a value chain analysis of Malaysia's seaweed sector, revealing that farmers face challenges such as low prices for dried seaweed and carrageenan, largely due to asymmetric information along the supply chain.

The seaweed industry is evolving from wild harvesting to farming, prompting a reassessment of its role in the global market. Selnes et al. (2021) emphasize the need for collaboration and innovation within European value chains, as producers must meet strict product standards set by lead firms. Similarly, Cerca et al. (2023) highlight the importance of upscaling macroalgal cultivation in Ireland to satisfy rising demand while ensuring sustainability. The transition towards cultivated seaweed in Europe underscores the need for efficient processing and distribution strategies to overcome existing challenges. Emblemstväg et al. (2020) propose that investments in cultivation infrastructure and biorefinery processes could improve the competitiveness of seaweed protein in fish feed markets, while Teniwut et al. (2017) identify asymmetric information as a barrier to production in Southeast Maluku. This approach aligns with findings from various studies, indicating that enhanced coordination and innovation in the seaweed value chain are crucial for developing high-quality products that meet market demands, thereby ensuring the sustainability and profitability of the emerging seaweed industry globally.

3. RESEARCH METHODS

This study took the object of research in South Sulawesi province, where there is an area that focuses on the seaweed cultivation industry, with a focus on the application of research results to MSMEs in West Sulawesi province. The sampling technique used was non-probability purposive sampling, where the participant criteria were cultivators and MSME actors in the seaweed sector (Adha et al., 2024). The research was carried out from January to December 2023, ensuring a comprehensive data collection period covering different production cycles.

The sampling technique used was non-probability purposive sampling, selecting 120 respondents comprising seaweed cultivators (60 respondents) and MSME actors (60 respondents) actively involved in cultivation, processing, and distribution. The selection criteria included:

1. Active involvement in the seaweed industry for at least three years.
2. Engagement in sustainable production or distribution practices.

3. Willingness to participate in in-depth interviews.

The research methodology was structured in two steps: the first was dedicated to the study of literature and in-depth interviews regarding sustainable communication and distribution strategies for MSME actors and seaweed cultivators, while the second step focused on a comparative study of several research objects consisting of the seaweed cultivation industry. In the first stage, we created a commercial strategy framework on sustainable communication and distribution, based on the results of the literature study and in-depth interviews, considering the lack of commercial strategies that can be adopted by MSMEs in the integrated industry in the seaweed sector. In the second stage, a comparative research method was adopted through qualitative. The second stage is closely related to the first stage, as this stage highlights a series of points that must be considered when selecting and analyzing research objects. In addition, the contextualization of theoretical principles is useful for analyzing sustainable communication and distribution strategies, which is done through a combination of causal mechanisms that allow for analyzing a phenomenon in its real-life context and dynamics (Dana et al., 2017).

4. RESULTS

This study aims to identify and analyze commercial strategies based on marketing and distribution communications that can improve the competitiveness of seaweed products in West Sulawesi province. By taking Bantaeng regency as a reference area, this study examines how an integrated ecosystem between business actors, government, and other supporting institutions can create synergy in product development and distribution of seaweed cultivation results, both for local, national, and international markets. The results of the study show that the existence of the Seaweed Cultivation Center plays a central role in this ecosystem. By comprehensively integrating the profit and non-profit sector approaches (Himo et al., 2019), functions as a liaison that optimizes collaboration between MSME cultivators, product processors, and distribution systems supported by local governments and universities (Himo et al., 2019; Haeruddin et al., 2017; Puspawati et al., 2018). Through this synergy, seaweed products can be processed more efficiently, distributed more widely, and marketed more competitively at various market levels. This study also highlights the importance of an effective communication strategy in supporting the marketing of seaweed products produced by local MSMEs. This strategy not only helps expand market reach, it can increase farmer productivity because it can reduce production costs and maximize land utilization (Cokrowati et al., 2021), and also increase the added value and competitiveness of products, which in turn will have a positive impact on community welfare and economic growth in the area.

Figure A.1 (see Appendix) illustrates the management and development flow of the Seaweed Cultivation Center, which involves various parties in the process, both for profit and non-profit. The following is the flow of the commercial strategy. Science Techno Park, designed and controlled by the University of West Sulawesi (Unsulbar) which has a role in supporting research and development of seaweed-related development technology (Haryati & Munandar, 2015)

in the West Sulawesi region. Seaweed agrotourism, agrotourism functions as a center for education and tourism based on seaweed cultivation. Seaweed waste processing carried out by the Mamuju Seaweed Waste Processing focuses on processing waste from seaweed cultivation activities, the dominant waste from used plastic bottles as buoys, this was initiated to control plastic waste in the waters.

Profit flow, Core Plasma Cooperation involves seaweed cultivator plasma (Suryana & Rizqi, 2020) and seaweed product processing plasma. This includes management from cultivation to the processing of seaweed products. Regional Government Cooperation includes the warehouse receipt system managed by local government, to ensure that seaweed products can be stored properly and marketed at optimal prices to increase farmers' income (Mardia et al., 2022). The seaweed cultivation process through MSME-based cultivator plasma, plasma receives seaweed seeds from cultivation centers and cultivates wet seaweed, wet seaweed is then processed into dry seaweed, then returned to the seaweed cultivation center, the rest of this process, such as seaweed bottle waste, is managed as waste in waste management in Mamuju.

Warehouse receipt system process is recommended to be managed directly by the local government. It receives wet and dry seaweed from cultivation centers to be stored and processed further. Wet seaweed, as seeds, can also be sold to seaweed farmers outside West Sulawesi, dry seaweed is exported through an export consignment system due to administrative processes that have not been fulfilled by farmers. Plasma process of processing seaweed products. Processed seaweed products, such as seaweed chips, are marketed to local, regional, and national markets.

The commercial strategy resulting from the research in Bantaeng regency places the Seaweed Cultivation Center as the center of activity, connecting various important elements in the seaweed ecosystem, both in the profit and non-profit sectors. acts as the main driver, supporting the interaction between the cultivator plasma, the processing plasma, and the warehouse receipt system. In the non-profit sector, collaboration with the Science Techno Park and the seaweed agrotourism program demonstrates efforts to develop cultivation technology while promoting environmental sustainability by processing seaweed waste. This also provides social contributions through empowering local communities.

In the profit sector, plasma cultivators based on MSMEs and plasma seaweed product processing are the keys in the business chain. Plasma cultivators produce seeds and manage seaweed cultivation, while plasma processors process derivative products such as seaweed chips that are directed to local, regional, and national markets. With the support of the warehouse receipt system in collaboration with the local government, price stability and product distribution efficiency can be guaranteed. This warehouse receipt system also opens up opportunities for West Sulawesi seaweed products to penetrate the international market through an export consignment system, providing opportunities for wider market expansion for local MSMEs. Overall, this model creates synergy between seaweed entrepreneurs with support from various parties, including the Government, Universities, and MSMEs. This center functions as a driving force that optimizes local resources, innovative technology, and plasma networks, so as to increase

the competitiveness of West Sulawesi seaweed products, while simultaneously overcoming challenges in distribution and marketing communication strategies in a sustainable manner.

To illustrate the key insights gained from stakeholder interviews, Table 1 presents a summary of perspectives from various stakeholders involved in the seaweed industry.

Table 1. Summary of key findings from stakeholder interviews

<i>Stakeholder category</i>	<i>Key findings</i>
Seaweed cultivators (farmers & processors)	Need for better access to quality seeds, financial support, and training to improve cultivation techniques. Increased reliance on MSME networks for product processing and distribution.
MSME owners	Identified challenges in market penetration, pricing, and product branding. Emphasized the importance of government support for storage and logistics through the warehouse receipt system.
Government officials	Recognized the role of seaweed cultivation centers in ensuring sustainability and economic development. Advocated for stronger policies on seaweed waste management and environmental conservation.
Industry stakeholders (supply chain & marketing)	Highlighted the need for an integrated export mechanism. Supported the export consignment system to overcome administrative barriers for small-scale farmers.

To enhance the clarity and impact of the findings, the findings have incorporated specific examples of successful implementations from the case studies. The first is seaweed cultivation centers and plasma cultivators. A key example of success is the role of the seaweed cultivation center in Bantaeng regency, which facilitates the integration of MSME cultivators and processors. For instance, the collaboration between MSME-based plasma cultivators and plasma processors has significantly improved the efficiency of both cultivation and product processing. This integrated approach has led to the production of high-quality dry seaweed, which is now being sold to national and international markets through a structured warehouse receipt system. This system not only ensures proper storage but also stabilizes prices, contributing to higher incomes for local farmers.

The second is agrotourism and environmental sustainability. The seaweed agrotourism program, based in West Sulawesi, has been an effective model for combining environmental sustainability and economic development. Through educational tourism, local communities have been empowered with new knowledge on sustainable seaweed cultivation techniques, while also benefiting from increased tourism revenue. The initiative has been successful in promoting both the environmental conservation of seaweed farming areas and the economic welfare of the community.

The third is seaweed waste processing. A successful example of circular economy implementation is the Mamuju Seaweed Waste Processing initiative. This project focuses on processing waste, particularly plastic bottles used as buoys in seaweed farming, which has reduced plastic pollution in the waters. In turn, this initiative not only contributes to environmental conservation but also provides additional revenue streams for local businesses by converting waste into valuable products. The fourth is the export consignment system. The integration of the export consignment system has been crucial in overcoming administrative barriers faced by local farmers. This system has enabled seaweed products from West Sulawesi to be exported more efficiently, allowing MSMEs to access international markets. For instance, the dried seaweed produced by plasma cultivators has been successfully exported, expanding the market reach and increasing the competitiveness of West Sulawesi's seaweed products. These case study examples underscore the effective collaboration between various stakeholders, including government agencies, universities, MSMEs, and local communities, in strengthening the seaweed industry

in West Sulawesi. The successful implementation of these initiatives highlights the importance of integrated systems in improving market access, ensuring sustainability, and fostering economic growth in the region.

5. DISCUSSION

The findings of this study on commercial strategies for seaweed products in West Sulawesi, particularly in Bantaeng Regency, align closely with previous research emphasizing the importance of integrated ecosystems for enhancing competitiveness. The central role of the Seaweed Cultivation Center as a hub for collaboration among MSME cultivators, processors, and local government resonates with Mulyati and Geldermann's (2017) insights on the need for comprehensive supply chain risk management to foster sustainable practices. By optimizing synergies among various stakeholders, this model can mitigate the uncertainties in yield and quality that Mulyati and Geldermann (2017) identified.

Additionally, the findings highlight effective communication strategies that can significantly enhance marketing efforts and farmer productivity, echoing the conclusions of Nor et al. (2020), which emphasize understanding market dynamics to improve value chains. The collaboration with the Science Techno Park and initiatives like seaweed agrotourism not only support technological advancements but also promote environmental sustainability, aligning with Cerca et al. (2023), who advocate for sustainable practices in seaweed cultivation. The incorporation of a warehouse receipt system to stabilize prices and improve distribution efficiency further supports Emblemssvåg et al. (2020), which stresses the importance of infrastructure investment in achieving scale in production. Overall, this integrated approach not only enhances the market competitiveness of West Sulawesi seaweed products but also addresses broader socio-economic and environmental challenges identified in the literature.

The findings of the study on the seaweed commercial strategies in West Sulawesi resonate with broader trends identified in the literature concerning sustainable seaweed production and value chain management. Blikra et al. (2021) emphasize the importance of using current tools to develop a sustainable food industry centered around seaweed products. Their insights highlight that integrating technology and innovation, as demonstrated by the Seaweed Cultivation Center in Bantaeng regency, is essential for optimizing

cultivation practices and improving product quality. By leveraging advanced agricultural techniques and research partnerships, the center can play a pivotal role in ensuring that seaweed production meets both local and international market standards, thereby enhancing the competitiveness of MSMEs.

Furthermore, Tabrani et al. (2024) identify key challenges in the Indonesian seaweed agroindustry, including market access and supply chain inefficiencies. The study's emphasis on creating an integrated ecosystem that connects cultivators, processors, and government entities addresses these challenges directly. The collaboration among stakeholders not only improves logistical efficiency but also fosters knowledge sharing, thereby increasing the overall capacity of the seaweed industry. Such integrated approaches can mitigate the issues of market fragmentation and enhance the stability of income for local farmers, as suggested by Zamroni and Yamao (2012), who noted the significant role of middlemen in ensuring sustainable livelihoods for small-scale fishermen.

The focus on communication strategies within the commercial framework is also supported by the research of Spillias et al. (2022), who highlight the role of effective communication in promoting sustainable development through seaweed farming. By improving marketing efforts and enhancing farmer productivity, the study aligns with findings that underscore the importance of community engagement and education in maximizing the potential of the seaweed sector. This engagement is crucial for building a resilient supply chain that can adapt to market demands and contribute to broader socio-economic benefits, a sentiment echoed by Thomas (2018) in his exploration of sustainability within the Swedish seaweed industry.

Lastly, the findings on sustainable marketing and distribution strategies for competitive MSMEs in the seaweed industry highlight a synergistic approach that aligns with established research. Segarwati et al. (2022) emphasize the integration of supply chain management and technology to enhance efficiency, while Widayati et al. (2023) stress the importance of sustainability and marketing orientation in driving performance. Lubis (2022) advocates for leveraging unique resources to craft tailored strategies, further supporting the need for MSMEs to adopt local knowledge. Muala (2023) underscores the significance of understanding local market dynamics, suggesting that partnerships and targeted marketing can effectively navigate challenges. Finally, the commercial strategy framework established aligns well with the perspectives of van den Burg et al. (2021) and Wale et al. (2022), who advocate for sustainable value chains that incorporate economic, environmental, and social dimensions. The integration of profit and non-profit sectors through initiatives like the Science Techno Park and seaweed agrotourism demonstrates a commitment to sustainability that can drive innovation and collaboration. As local government initiatives like the warehouse receipt system stabilize prices and enhance distribution efficiency, they further enable West Sulawesi's seaweed products to access both national and international markets.

However, to ensure the successful expansion of the seaweed commercialization model, it needs to address key factors such as implementation challenges, scalability considerations, and risk

mitigation strategies. One of the main challenges to the successful implementation of the seaweed commercialization strategy in West Sulawesi is the limited access to quality seeds and financial support, which is critical for small-scale seaweed cultivators. Many farmers face financial constraints that prevent them from upgrading their cultivation techniques or expanding their production capacity. Additionally, logistical issues such as inadequate transportation infrastructure and storage facilities in remote areas lead to delays and higher costs, which can reduce the overall efficiency of the seaweed supply chain. Furthermore, there are gaps in the regulatory framework for seaweed waste management and environmental conservation, which hinders the broader adoption of best practices and sustainable farming methods. Addressing these challenges will require targeted support in terms of financial resources, infrastructure development, and stronger regulatory policies to ensure sustainability and growth in the sector.

Furthermore, for the successful model of seaweed commercialization in West Sulawesi to be scalable to other regions, it is essential to tailor the approach to the specific conditions of each new area. Regional differences in infrastructure, access to technology, and local market dynamics must be taken into account when adapting the model. For example, the warehouse receipt system and export consignment system, which have proven effective in West Sulawesi, must be flexible enough to meet the needs of different regions with varying logistical and administrative capabilities. Furthermore, scaling up the model requires strengthening local partnerships, particularly with government agencies and universities, to ensure that regions outside West Sulawesi receive the necessary technical support and research to implement the strategy effectively. By adapting the model to fit local contexts and building strong local networks, the seaweed industry can expand successfully to other regions and achieve sustainable growth.

Lastly, to mitigate risks that could threaten the sustainability of the seaweed industry, several strategies need to be in place. One key strategy is to diversify seaweed products to reduce dependency on a single product line and to stabilize income, especially in the face of market price fluctuations. For example, developing value-added products such as seaweed chips can open up new markets and help secure stable revenue streams for farmers. Additionally, environmental risks, such as seaweed diseases and climate-related challenges, can be minimized by introducing disease-resistant seed varieties and establishing a robust insurance scheme for farmers to protect against crop failures. These measures not only help safeguard farmers' livelihoods but also contribute to the long-term sustainability of the seaweed industry. Furthermore, fostering strong communication channels among all stakeholders, including farmers, government agencies, and businesses, will enable quick responses to emerging risks and challenges, ensuring that the seaweed industry remains resilient in the face of uncertainties.

6. CONCLUSION

This study demonstrates the significant potential of the seaweed industry in West Sulawesi, particularly in Mamuju Regency, to drive local economic growth through the integration of the MSME sector.

The Seaweed Cultivation Center's role as a strategic hub has been pivotal in connecting various key stakeholders across the seaweed value chain, ranging from cultivators and product processors to distributors and marketers. The synergistic collaboration between MSME-based cultivator plasma, product processing plasma, and the warehouse receipt system, with local government support, has proven effective in improving production and distribution efficiency, both domestically and internationally.

This research underscores the importance of a tailored marketing communication strategy that enhances the competitive positioning of West Sulawesi's seaweed products. Furthermore, the development of a robust and sustainable distribution system, driven by innovative technology and multi-sector cooperation, has the potential to significantly increase product value, expand market access, and contribute to the long-term sustainability of the seaweed industry. These developments are essential not only for improving price stability and distribution efficiency but also for

unlocking new export opportunities, thereby benefiting the local economy and community welfare.

While the study provides a comprehensive overview of the current seaweed industry in the region, it also highlights several areas for future research. Specifically, exploring the long-term impacts of technological innovations on production efficiency, the potential for further expansion into international markets, and the development of sustainable farming practices should be prioritized. Additionally, investigating the effects of climate change on seaweed cultivation and product quality could offer critical insights for adapting to future challenges.

However, the study also faces some limitations. It primarily focuses on the Mamuju regency, and thus, the findings may not be fully generalizable to other regions of West Sulawesi or Indonesia. Moreover, while the research highlights key stakeholders in the seaweed value chain, it does not deeply explore the socio-economic impacts on local communities or assess the environmental sustainability of large-scale seaweed farming.

REFERENCES

- Adha, W. M., Mas'ud, A. A., & Erwin. (2024). Digital marketing development strategy of cocoa products. *Revista de Gestão Social e Ambiental*, 18(6), Article 05305. <https://doi.org/10.24857/rgsa.v18n6-022>
- Ahmed, Z. U., Hasan, O., Rahman, M. M., Akter, M., Rahman, M. S., & Sarker, S. (2022). Seaweeds for the sustainable blue economy development: A study from the south east coast of Bangladesh. *Heliyon*, 8(3), Article 09079. <https://doi.org/10.1016/j.heliyon.2022.e0907>
- Arbit, N. I. S., Syamsuddin, F., Tabrani, M., Carong, S. R., Erwin, & Lestari, D. (2023). *Optimalisasi potensi rumput laut sebagai penguatan ekonomi masyarakat pesisir di kabupaten Majene* [Optimizing seaweed potential as an economic strengthening of coastal communities in Majene regency]. Conservation Strategy Fund.
- Blikra, M. J., Altintzoglou, T., Løvdal, T., Rognsø, G., Skipnes, D., Skåra, T., Sivertsvik, M., & Fernández, E. N. (2021). Seaweed products for the future: Using current tools to develop a sustainable food industry. *Trends in Food Science & Technology*, 118(Part B), 765–776. <https://doi.org/10.1016/j.tifs.2021.11.002>
- Cerca, M., Sosa, A., & Murphy, F. (2023). Responsible supply systems for macroalgae: Upscaling seaweed cultivation in Ireland. *Aquaculture*, 563(Part 2), Article 738996. <https://doi.org/10.1016/j.aquaculture.2022.738996>
- Cokrowati, N., Junaidi, M., Diniarti, N., Scabra, A. R., & Sunaryo, S. (2021). Introduksi "Bondre" untuk mengatasi gagal panen rumput laut pada cuaca ekstrim di pantai Jelenga kabupaten, Sumbawa barat [Introduction of "Bondre" to overcome seaweed crop failure in extreme weather on Jelenga beach, West Sumbawa regency]. *Journal of Master of Science Education Service*, 4(3). <https://doi.org/10.29303/jpmppi.v4i3.946>
- Dana, L. P., Giacosa, E., Culasso, F., & Stupino, M. (2017). A new communication and retail distribution formula in food sector. *Global Business and Economics Review*, 19(2), 137–156. <https://doi.org/10.1504/GBER.2017.082590>
- Emblemsvåg, J., Kvadsheim, N. P., Halfdanarson, J., Koesling, M., Nystrand, B. T., Sunde, J., & Rebours, C. (2020). Strategic considerations for establishing a large-scale seaweed industry based on fish feed application: A Norwegian case study. *Journal of Applied Phycology*, 32, 4159–4169. <https://doi.org/10.1007/s10811-020-02234-w>
- Erwin, E., & Muthmainnah, A. (2023). Efek moderasi sensitivitas harga antara determinan yang dirasakan dan minat beli produk UMKM hasil budidaya rumput laut: Konsumen provinsi Sulawesi Barat [Moderating effect of price sensitivity between perceived determinants and purchase intention of seaweed cultivation MSME products: Consumers of West Sulawesi province]. *Jurnal Manajemen STIE Muhammadiyah Palopo*, 9(2), 435–441. <https://doi.org/10.35906/jurman.v9i2.1685>
- Haeruddin, A., Pujilestari, T., & Atika, V. (2017). Pengaruh jenis pelarut terhadap hasil ekstraksi rumput laut gracilaria sp. sebagai zat warna alam pada kain batik katun dan sutera [Solvent type effect to seaweed Gracilaria's sp. extraction as natural dyes on cotton and silk batik fabric]. *Dinamika Kerajinan dan Batik: Majalah Ilmiah*, 34(2), 83–92. <https://www.researchgate.net/publication/323311587>
- Hafting, J. T., Craigie, J. S., Stengel, D. B., Loureiro, R. R., Buschmann, A. H., Yarish, C., Edwards, M. D., & Critchley, A. T. (2015). Prospects and challenges for industrial production of seaweed bioactives. *Journal of Phycology*, 51(5), 821–837. <https://doi.org/10.1111/jpy.12326>
- Haryati, S., & Munandar, A. (2015). Pemberdayaan masyarakat wirausaha mandiri berkelanjutan melalui diversifikasi olahan produk berbasis rumput laut eucema cottonii di desa Lontar, kecamatan Tirtayasa, provinsi Banten [Community empowerment of sustainable self-employment through diversification of seaweed-based products in Lontar village, Tirtayasa district, Banten province]. *Jurnal Perikanan dan Kelautan*, 5(2), 67–78. <https://doi.org/10.33512/jpk.v5i2.1066>
- Himo, R., Durand, S., & Dien, C. R. (2019). Strategi agribisnis budidaya rumput laut di desa Buku Utara kecamatan Belang kabupaten Minahasa Tenggara provinsi Sulawesi Utara [Agribusiness strategy for seaweed cultivation in Buku Utara village, Belang district, Southeast Minahasa regency, North Sulawesi province]. *Akulturas: Jurnal Ilmiah Agribisnis*, 7(1), 1039–1048. <https://doi.org/10.35800/akulturas.7.1.2019.24394>
- Jamaludin, M. (2022). Indonesia's food security challenges: How food SOE optimizes its role?. *Research Horizon*, 2(3), 394–401. <https://doi.org/10.54518/rh.2.3.2022.394-401>
- Lubis, N. W. (2022). Resource based view (RBV) in improving company strategic capacity. *Research Horizon*, 2(6), 587–596. <https://doi.org/10.54518/rh.2.6.2022.587-596>

- Mac Monagail, M., Cornish, L., Morrison, L., Araújo, R., & Critchley, A. T. (2017). Sustainable harvesting of wild seaweed resources. *European Journal of Phycology*, 52(4), 371–390. <https://doi.org/10.1080/09670262.2017.1365273>
- Mardia, Fachrie, M. E., & Daniar. (2022). Analisis kebijakan sistem resi gudang komoditi rumput laut (*Gracilaria* sp) d kabupaten Takalar [Policy analysis of the seaweed commodity warehouse receipt system (*Gracilaria* sp) in Takalar district]. *Agrovital: Jurnal Ilmu Pertanian*, 7(2). <https://doi.org/10.35329/agrovital.v7i2.3535>
- Martiawan, R., Achdiat, A., Ruyani, N. R., Ediyanto, E., & Jamaludin, M. (2023). Analysis of food security in regional context: West Java provincial government as a case study. *Research Horizon*, 3(1), 1–8. <https://doi.org/10.54518/rh.3.1.2023.613-620>
- Muala, B. (2023). Exploring rice marketing strategies: A case study of Toili sub-district, Banggai regency. *Research Horizon*, 3(3), 215–223. <https://journal.lifescifi.com/index.php/RH/article/view/123>
- Mulyati, H., & Geldermann, J. (2017). Managing risks in the Indonesian seaweed supply chain. *Clean Technologies and Environmental Policy*, 19, 175–189. <https://doi.org/10.1007/s10098-016-1219-7>
- Nor, A. M., Gray, T. S., Caldwell, G. S., & Stead, S. M. (2020). A value chain analysis of Malaysia's seaweed industry. *Journal of Applied Phycology*, 32, 2161–2171. <https://doi.org/10.1007/s10811-019-02004-3>
- Puspawati, N. N., Sugitha, I. M., & Wisaniyasa, N. W. (2018). Introduksi pengolahan rumput laut menjadi bakpia di desa Lembongan, kabupaten Klungkung [Introduction of seaweed processing into bakpia in Lembongan village, Klungkung regency]. *Buletin Udayana Mengabdi*, 17(4), 232–237. <https://doi.org/10.24843/BUM.2018.v17.i04.p08>
- Segarwati, Y., Nurhayati, N., Nurkania, T., Yuniarti, Y., & Jamaludin, M. (2022). Implementation of supply chain management using the ERP system at XYZ Company Indonesia. *Research Horizon*, 2(6), 561–567. <https://doi.org/10.54518/rh.2.6.2022.561-567>
- Selnes, T., Giesbers, E., & van den Burg, S. W. (2021). Innovation and collaboration: Opportunities for the European seaweed sector in global value chains. *Journal of Marine Science and Engineering*, 9(7), Article 693. <https://doi.org/10.3390/jmse9070693>
- Spillias, S., Cottrell, R. S., Kelly, R., O'Brien, K. R., Adams, J., Bellgrove, A., Kelly, B., Kilpatrick, C., Layton, C., Macleod, C., Roberts, S., Stringer, D., & McDonald-Madden, E. (2022). Expert perceptions of seaweed farming for sustainable development. *Journal of Cleaner Production*, 368, Article 133052. <https://doi.org/10.1016/j.jclepro.2022.133052>
- Stévant, P., & Rebours, C. (2021). Landing facilities for processing of cultivated seaweed biomass: A Norwegian perspective with strategic considerations for the European seaweed industry. *Journal of Applied Phycology*, 33, 3199–3214. <https://doi.org/10.1007/s10811-021-02525-w>
- Suryana, A., & Rizqi, G. S. (2020). Pengaruh sistem kemitraan inti-plasma terhadap jaminan pasar, kualitas baglog jamur tiram putih dan kepuasan petani di cv. Asa Agro Corporation kecamatan Cugenang kabupaten Cianjur [The effect of the inti-plasma partnership system on market security, white oyster mushroom baglog quality and farmer satisfaction at cv. Asa Agro Corporation, Cugenang district, Cianjur regency]. *Agrita*, 2(2). <https://doi.org/10.35194/agri.v2i2.1171>
- Tabrani, Angkasa, W. I., & Deviarini, I. M. (2024). Analysis of seaweed agroindustry management in Indonesia: Potential, challenges, and prospects. *Science Journal of Business and Management*, 10(4), 27–38. <https://doi.org/10.11648/j.sjbm.20241202.11>
- Teniwut, W. A., Betaubun, K. D., & Djatna, T. (2017, October). A conceptual mitigation model for asymmetric information of supply chain in seaweed cultivation. In *IOP conference series: Earth and environmental science* (Vol. 89, Article 012022). IOP Publishing. <https://doi.org/10.1088/1755-1315/89/1/012022>
- Thomas, J. B. E. (2018). *Insights on the sustainability of a Swedish seaweed industry* [Doctoral dissertation, KTH Royal Institute of Technology]. <https://www.researchgate.net/publication/326930585>
- Van den Burg, S. W. K., Dagevos, H., & Helmes, R. J. K. (2021). Towards sustainable European seaweed value chains: A triple P perspective. *ICES Journal of Marine Science*, 78(1), 443–450. <https://doi.org/10.1093/icesjms/fsz183>
- Wale, C., Nagabhatla, N., Yeojin, K., & Cottier-Cook, E. J. (2022). Trends and patterns of the seaweed industry and its links with SDGs. In W. Leal Filho, A. M. Azul, L. Brandli, A. Lange Salvia, & T. Wall (Eds.), *Life below water* (pp. 1–17). Springer. https://doi.org/10.1007/978-3-319-71064-8_128-2
- Widayati, T., Nurchayati, N., Suparmi, S., & Suprapti, S. (2023). The Effect of sustainability orientation and marketing orientation on marketing performance in SMEs. *Research Horizon*, 3(2), 60–70. <https://journal.lifescifi.com/index.php/RH/article/view/102>
- Yong, W. T. L., Thien, V. Y., Misson, M., Chin, G. J. W. L., Hussin, S. N. I. S., Chong, H. L. H., Yusof, N. A., Ma, N. L., & Rodrigues, K. F. (2024). Seaweed: A bioindustrial game-changer for the green revolution. *Biomass and Bioenergy*, 183, Article 107122. <https://doi.org/10.1016/j.biombioe.2024.107122>
- Yustinah, Y., Noviyanti, S., Hasyim, U. H., & Syamsudin, A. B. (2019). Pengaruh penambahan kitosan dalam pembuatan plastik biodegradabel dari rumput laut *Gracilaria* sp dengan pemplastik sorbitol [Effect of chitosan addition in making biodegradable plastic from *Gracilaria* sp seaweed with sorbitol plasticizer]. *Prosiding Semnastek*. <https://jurnal.umj.ac.id/index.php/semnastek/article/view/5188>
- Zamroni, A., & Yamao, M. (2012). An assessment of farm-to-market link of Indonesian dried seaweeds: Contribution of middlemen toward sustainable livelihood of small-scale fishermen in Laikang Bay. *African Journal of Agricultural Research*, 7(30), 4198–4208. <https://www.researchgate.net/publication/231537775>

APPENDIX

Figure A.1. Commercial strategy framework on sustainable communication and distribution

