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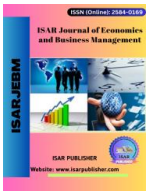

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CASE STUDY OF INDONESIA'S SEAWEED SUSTAINABILITY: TRACEABILITY KAPPAPHYCUS ALVAREZII IN LOMBOK

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Abstract: *Indonesia is one the world's largest producer of Kappaphycus alvarezii, it needs to enhance access traceability within the supply chain and the precise identification of commercial K. alvarezii seed varieties are among the primary challenges. It has become a complex and imperative necessity to ensure the sustainable administration of the K. alvarezii cultivation industry. Significant economic losses can be the result of sustainability failures, which can have a cascading effect on related sectors, particularly local industries, and impact multiple stakeholders within industry. The objective of this paper is to highlight K. alvarezii Industries in Indonesia particularly, in the context of seaweed sustainability. The research concentrates on a seaweed industry hub with considerable biodiversity in Lombok. First, introduction about K. alvarezii in Indonesia, especially in lombok. Second, traceability of K. alvarezii Industries in Indonesia are presented and discussed. As conclusion, K. alvarezii industries database as an optimization method for seaweed industries in Indonesia may provide key sources of information that can be tools for sustainability of ecosystems and related living resources management. The results will help Indonesia's seaweed sector become more sustainable and traceable.*

Keywords: *Kappaphycus alvarezii, Traceability Studies, Lombok.*

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I. INTRODUCTION

Indonesia is the World's Largest Archipelagic Country, with Large Potential in Marine Resources. It is also the largest archipelagic in a strategic location with the world's fourth largest population. With Rich in ocean biodiversity and high ocean resources potential, Indonesia is World's 2nd largest Seaweed producer. Indonesia Seaweed Cultivation Households in Indonesia can be source of Zero fertilizer and Low CO2 emission. Indonesia's natural resources for seaweed can be said to be very abundant which contributing 30% of total exports in the world. This makes Indonesia rank 1st but 3rd rank in international seaweed trade due to Indonesia's exports commonly in raw materials or low value-added products. This is why Indonesia is becoming one of the major producers *Kappaphycus alvarezii* in the world with over 23 million tons of aggregated production. However, we need the right way to maximize *K. alvarezii* industries in Indonesia, one of which is through the application of science management especially related traceability and supply (KKP, 2024).

Starting in 1967 until now, Indonesia have potential for seaweed processing to finished or semi-finished products. At that time, Cultivation of Eucheuma spinosum was first initiated by Soerjodinoto from Department of Hydrography and Oceanography of Indonesian Navy in Tikus Island (Thousand Islands) assisted by Hariadi Adnan. In 1984, Hariadi Adnan attempted to plant *K. alvarezii* (previously known as *E. cottonii*). Then, South Sulawesi Government with Hasanuddin University and local entrepreneurs;

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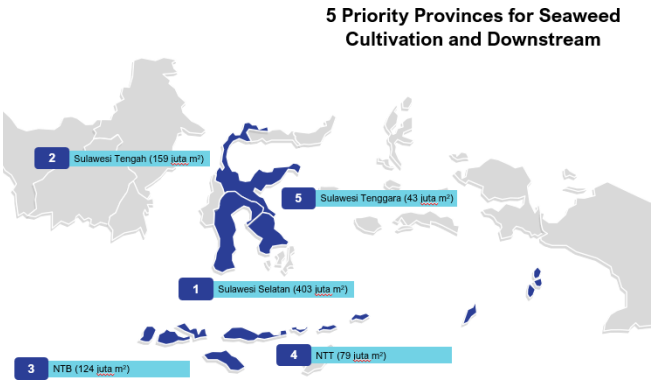
Aksa Mahmud and Safari Azis collaborated to farm *Gracilaria sp.* in Makassar. In 1989 until now, public interest started growing towards seaweed farming and industries. Since establishment of Association of Indonesian Seaweed Farmer and Industries (APBIRI) in 1989 changed into Indonesian Seaweed Association (ARLI) in 1998. (ARLI, 2020)

In Global Seaweed Production, Indonesia occupies the second highest position after China in 2016. Even though China was the highest producer at that time, now China is the first destination for seaweed exports and the highest in receiving Indonesian seaweed exports. (FAO, 2020) Therefore, based on The National Medium-Term Development Plan (RPJMN) 2020-2024, Seaweed is an important Aquaculture Commodity. The National Medium-Term Development Plan 2020-2024 mentioned to increase research capacity in fisheries and marine sectors. Seaweed Production having Target increasing 12,30 Million Tons in 2024. (PP No. 18/2020 tentang RPJMN 2020-2024). Based on distribution of the seaweed production in Indonesia, There are 5 (five) priority Provinces for seaweed cultivation and downstream namely, Sulawesi Selatan, Sulawesi Tengah, Nusa Tenggara Barat, Nusa Tenggara Timur, and Sulawesi Tenggara.

Picture 1. Potential Area for Downstream Seaweed Industries



Source:
1) Ministry of Marine Affairs and Fisheries (2022)
2) Presidential Regulation 33/2019

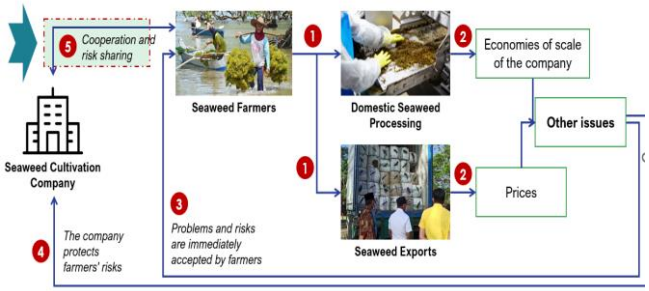
II. Objective

. Indonesia is the third largest exporter of carrageenan as a semi-finished material for seaweed in value and quantity and the lowest price per ton. Although Indonesia has many seaweed processing companies within the country, but still in behind other countries. There are several Challenges of Carrageenan Industries in Indonesia. For instance, seaweed farmers in Indonesia still cannot handle the impact of seasonal changes. They still need intensive assistance to carry out professional seaweed cultivation. Moreover, Indonesian seaweed has lower price due to its low quality. It is because the price of seaweed in Indonesia is strongly influenced by the level of demand for seaweed from China. In this research, the authors are trying to implement Pilot Project particularly for Implementing Large-Scale Seaweed Productivity Improvement Innovations.

III. Pilot Project For Implementing Large-Scale Seaweed Productivity Improvement Innovations

Although Indonesia has tremendous potential as a seaweed-producing country, there are several big challenges that need attention, including domestic seaweed processing; economies of scale of the company; and cooperation and risk sharing. Apart from that, there are challenges of seaweed industries in Indonesia which can be seen in these following pictures:

Picture 2. Challenges of Seaweed Industries in Indonesia



In this case, Seaweed Industry needs to have Development Strategy in order to improve the professionalism in industries. Institutionalism and professionalism on the upstream side are critical points in the down streaming of Indonesian seaweed, especially the protection of seaweed cultivation farmers. This research trying to Mapping of Potential Location for Seaweed Farming (Industrial Scale) in West Nusa Tenggara with Research Survey in Ekas Bay Location.

Picture 3. Research location in Ekas Bay

IV. Sustainability Of Seaweed Industries

In maintaining the sustainability of seaweed industries, there are 4 (four) main values that are included and in accordance with the values of the Sustainable Development Goals (SDGs), namely, SDGs number 3, 9, 11, and 13. There are Good Health and Well-Being; Industry, Innovation, and Infrastructure; Sustainable cities and communities; Climate Action. That Contribution to (SDGs) also based on the development of environmentally friendly products, e.g., Area Management (*goal of the regulatory authorities*) and High quality and output with high priced product (*goal of seaweed industries*).

4.1. Network Studies (Supply and Value Chain)

Seaweed cultivation which will later be processed into Carrageenan starts from harvesting at sea by seaweed farmers. Farmers are divided into two namely, independent farmers and dependent farmers. Meanwhile, local collectors who can also be referred to as Carrageenan producers usually take their seaweed harvest directly from farmers, because the price is cheaper. These three categories deposit their harvests to large traders who can also be categorized as exporters. Furthermore, large traders will provide their harvests to factories to produce Carrageenan, both national and multinational. After that, it is processed to food or non-food industries, and the other most important part is the export of Carrageenan to the international market.

4.2. SWOT Analysis

Through the SWOT framework, the author tries to further analyze what are the Strengths, Weaknesses, Opportunities and Threats on the carrageenan industry supply chain in indonesia. This SWOT framework is to describe the supply chain that occurs in the *K. Alvarezii* Carrageenan industries in Indonesia, which then helps to map the flow of maximizing *K. Alvarezii* industries. In here, Opportunity is powered by Strengths. Then, Opportunity is limited by Weaknesses. Strengths are vulnerable by the presence of threats, weakness and threaten our problems in the seaweed industries.

Table 1. SWOT Analysis on the Seaweed Industry Supply Chain in Indonesia

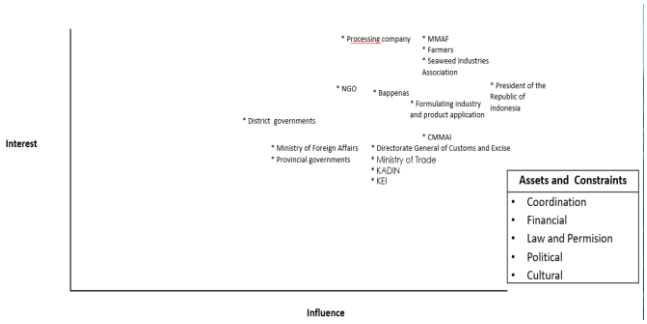
Strengths	Opportunities
• Many seaweed farmers • Large seaweed area production	• Improving quality of seaweed products by conducting national standardization • Increasing innovation and number of technologies in seaweed processing • Encouraging the development of processing industries in seaweed production centers • Collaboration among stakeholders is truly needed • Large coastal line means more seaweed growing • No new agricultural land is needed • Growing seaweed is relatively simple • The demand for seaweed production is keep growing
Threats	**Weaknesses**
• Lack of regeneration of young farmers in the future • High price fluctuations for seaweed production • Short term relationships between producer and buyer • Climate Change • Loans and payment systems are feared to make seaweed farmers not independent	• The quality of seaweed is not similar • Low productivity of seaweed cultivation • Lack of capital • Weak in innovation and development • Long market distribution chain • Low education level of smallholder farmers • Inadequate communication infrastructure and lack of communication equipment by farmers

From the table above, we can see that Indonesia already has two main factors in developing seaweed industry, both external (export) and internal (domestic) markets. Indonesia has many seaweed farmers who are ready to process seaweed with high productivity. Unfortunately, the seaweed industries in Indonesia also have several weaknesses. Even though Indonesia has a lot of natural seaweed resources and many seaweed farmers, the quality of seaweed produced by farmers is not evenly distributed. If this condition continues, we argue that this could affect the price fluctuations of seaweed and export demand, as well as the uneven income of seaweed farmers in Indonesia. Low productivity of seaweed cultivation occurs because of the lack of technology that can assist processing. The lack of innovation and existing technology will not only affect the productivity of seaweed cultivation at this time, but we also predict that this deficiency will affect the future of seaweed cultivation in the future.

4.3. Stakeholder and Institutional Analysis

Stakeholder and Institutional Analysis based on production flow that starts with seaweed farmers manufacture for export. Independent farmers, local producers and dependent farmers will send to large traders towards seaweed manufactures, both national and multinational; and finally end to food industries, non-food industries and export markets. Therefore, this market also depends on quantity, quality and price. Therefore, they have several challenges that influence the market and product. e.g., improving seaweed production; development of seaweed farming location; establishment of seaweed nursery ground; training of good farming practices to farmers; development of *Research and Development*; revitalization of the existing local industries; and supporting regulations for seaweed industries. Besides, there is also Variable quality in the production of seaweed raw material, Cyclic availability and price, Regional spatial planning, Daily life requirements of seaweed farmers, Infrastructure and transportation, Weak in innovation and development, Poor knowledge about hydrocolloids and Local regulations. Moreover, stakeholders and institutionals involved along with their respective influences and interests. This analysis is taken from various sources and maybe will be different from other people's perspectives.

Picture 3. Stakeholder and Institutional Analysis

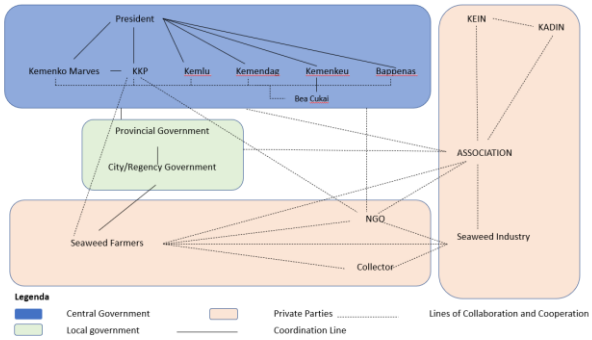


For central government, beside regulator with academician, research institution also give suggestions and inputs in sparring partners from the regulator's point of view. Seaweed Association become a representative of seaweed industry stakeholders from farmers to industry and convey messages to relevant government agencies about existing problems that need special attention from the government and give suggestions and inputs in sparring partners from the point of view of seaweed cultivation and processing businesspeople. Processing companies (local and foreign companies) are Seaweed industry users affecting the seaweed industry business. Furthermore, farmer who are managing seaweed cultivation and/or providing resources for seaweed cultivation. In this condition, we know that President is the highest position who is a Policy holder and the highest executive institutions and lead ministers or heads of ministries and institutions that related to the seaweed industry. Moreover, the lowest hierarchy is district government that responsible for managing, supporting, and providing necessary services to local farmers and supporting local administration.

4.4. Relation Analysis

Based on relation analysis between actors involved. In this case, NGO and collectors play role as intermediary between farmers, private parties and central government. The local government provides policy support to central government, which can be seen in these following pictures:

PICTURE 4. RELATION ANALYSIS



From this picture, we can see that Seaweed Industry needs Integrated Policy in order to build an End-to-End Seaweed Downstream Ecosystem, from seedling until market. Seedling is looking for quality seeds with high productivity and disease resistance and collaboration to improve the quality of seaweed seeds. Farming needs encouraging large-scale cultivation; and acceleration and ease of permits for the use of sea space for seaweed cultivation. Therefore, it is necessary to distinguish between marine space for industry vs traditional farmers. In part of harvesting, requirements expanding access to mechanization and technology for farmers. There needs to be a model of cooperation or assistance for farmers, like development of technology and mechanization by BRIN and BUMN. At processing, they need to provision of incentives and ease of licensing for investment in the seaweed industry, including distribution permits; allocation of industrial areas for seaweed processing; basic infrastructure improvements in cultivation areas; and preparation of KBLI and standards for new products such as bio stimulants. Finally, we can identified their needs based on their market sector: business matching forum with the food industry (*Food*); affirmative action in the form of a pilot project by the Ministry of Agriculture or BUMN for bio stimulant or seaweed fertilizer (*Agriculture*); expansion of restrictions on the use of regular plastics in various regions (*Bioplastics*) and research collaborations and pilots between state-owned enterprises, the private sector, universities (*Biofuels*).

V. CONCLUSION AND RECOMMENDATIONS

Seaweed Industry needs the Development Strategy related to seaweed policies. Therefore, government needs to prepare a policy framework to protect seaweed farmers in various aspects, such as prices, research, etc. The analysis studies that based on the supply chain in the seaweed industry in Indonesia starting from seeding, planting or cultivation and harvesting and post-harvest handling in the upstream sector; while local and foreign trade; processing industry; industrial application products in the downstream sector can help make database as an optimalization method for seaweed industries in Indonesia. It also may provide key sources of information that can be a useful tool for sustainability ecosystems and related living resources management.

There are several recommendations to become a market leader for the carrageenan and gelatinous industries. Hopefully also the processing of seaweed can also make environmentally friendly products. First, the existing seaweed farming activity needs more improvement related the good practice and spatial management. Second, application of science and technology to improve seaweed production and to support the sustainability of seaweed farming are good and needed. However, discretion in applying them for real practice are advised for the public interest. Furthermore, it is important to re-educate them about the development of seaweed industries and market, also to introduce them with the newest technology that might facilitate their farming. Lastly, it is also crucial to introduce them to financial institutions other than bank.

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