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POLICY BRIEF
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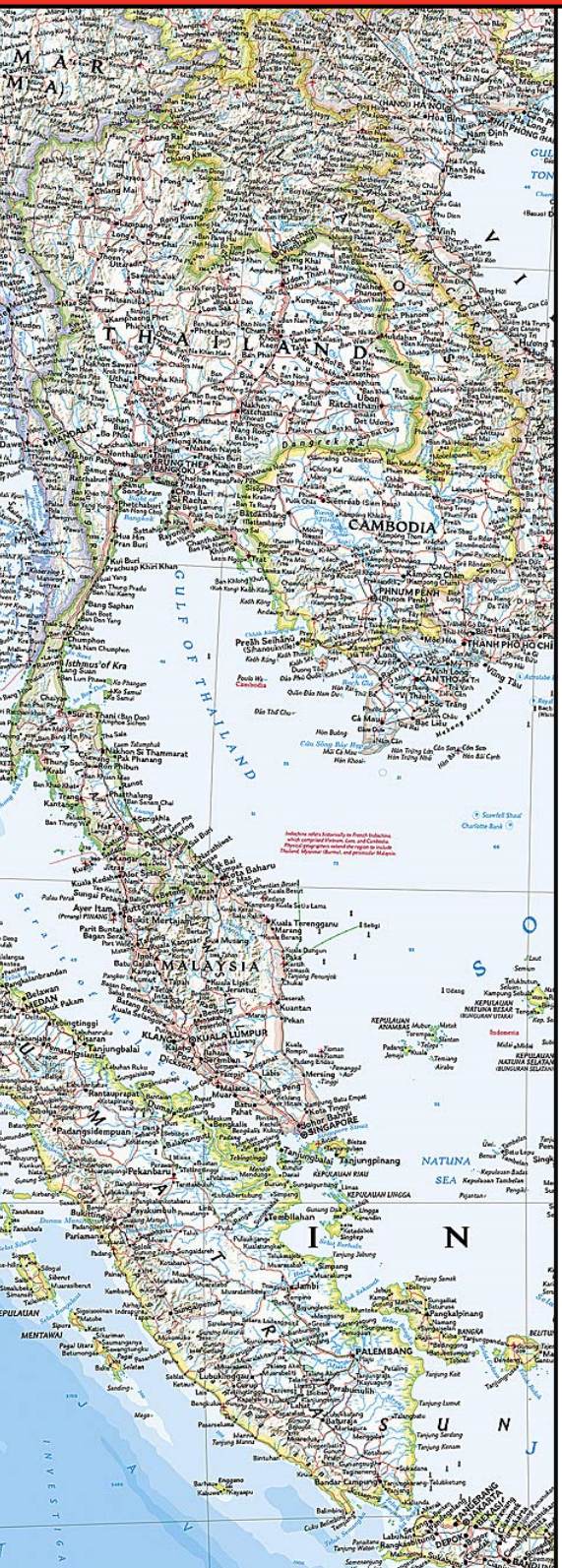
Sustainable Value Chain for the Seaweed Industry in Malaysia and the ASEAN Region: A Roadmap for Policy Formulation



Highlights

- Sustaining economic interest in Malaysian seaweed cultivation and ensuring price stability will require coordination of downstream value chain activities including marketing and trading.
- Incentives and financial support for Small Medium Enterprises (SMEs) and private sector investments could spearhead innovation in diversified seaweed-based value-added products. This can help to create a sustainable demand for seaweeds and derived products.
- Implementation of biosecurity measures is essential for managing production risks such as pests and diseases outbreaks, enhancing productivity, and reducing losses.
- Advancing a stable supply of healthy seedlings for cultivation remains key to ensuring the sustainability of seaweed value chains and the industry in Malaysia and the ASEAN region.

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Disclaimer

Overview

Global production of seaweeds is undergoing a rapid expansion, at a time of accelerating climate change, raising new challenges for producers and the environment (Fig. 1).

Seaweed aquaculture plays an important role in the economy of the Asian region (Cai et al. 2021). The share of Asia's contribution to global seaweed production in 2019 was 97% of the total 35.8 million tonnes produced (FAO, 2021). Cultivation of the eucheumatoid seaweeds *Kappaphycus* and *Eucheuma* is a major contributor to the economy, food supply, and rural livelihoods in the ASEAN region (Cai et al. 2021).

For Malaysia, the annual revenue from the seaweed industry is over USD 14 million, contributing approximately 50% of the total

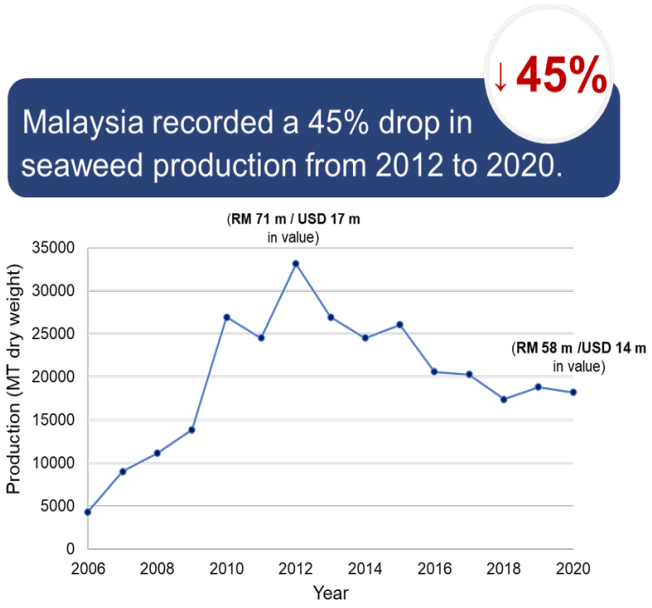

Figure 1. Annual seaweed production in Malaysia from 2006 to 2020 (18,204 million tonnes dry weight in 2020) (based on data from the Department of Fisheries Malaysia, 2021)

national aquaculture production in 2020. Despite its importance to the economy and livelihood of the coastal communities (Asri et al. 2021), the total production of seaweed in Malaysia has declined over the past decade (Figure 1). The Department of Fisheries in Malaysia notes that over 1000 farmers are currently involved in

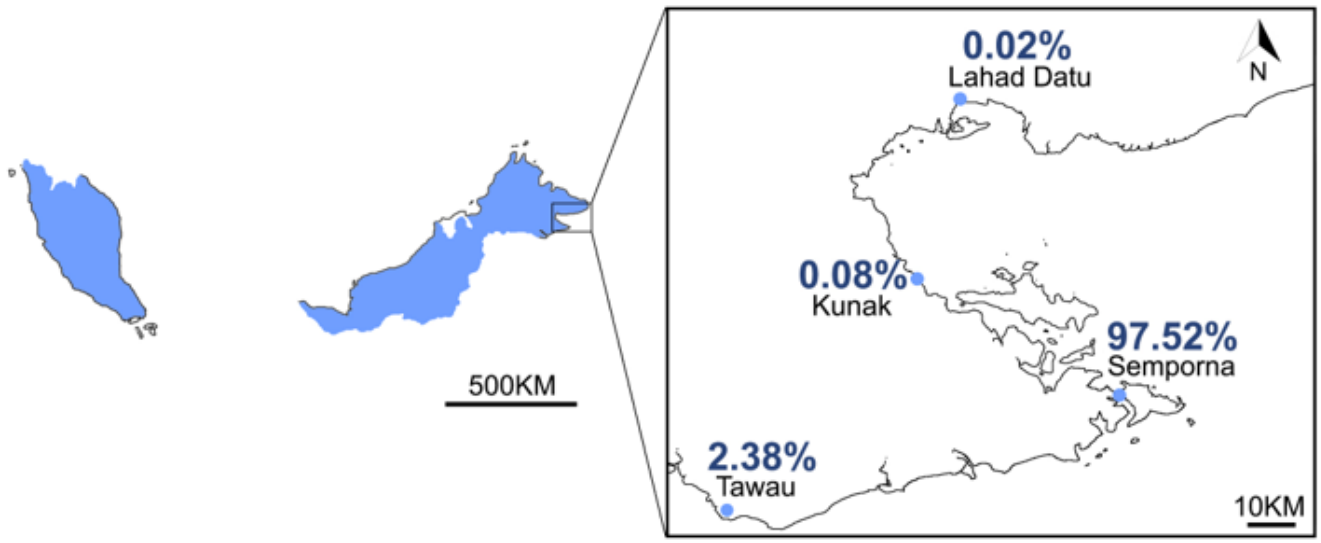

Figure 2. Breakdown of seaweed production in 2020 by location in Sabah, Malaysia.

seaweed cultivation, mainly concentrated in Sabah (Figure 2), where *Kappaphycus* and *Eucheuma* are farmed for carrageenan, a raw material widely used in the food, pharmaceutical, and cosmetics industries (about 4,500 tonnes of carrageenan can be produced from 18,000 tonnes of dried *Kappaphycus* and *Eucheuma)*. In the past, at least three local carrageenan processing factories existed to support the seaweed value chain; however, they ceased all operations in 2020.

This policy brief derives from the empirical research in Malaysia funded by the United Kingdom Research and Innovation's Global Challenges Research Fund (BB/P027806/1, IF015-2019) through the GlobalSeaweedSTAR programme, and support provided by the Ministry of Higher Education Malaysia through the Higher Institution Center of Excellence grant (IOES-2014H). It outlines key gaps and needs that can guide the creation of a sustainable value chain for the Malaysian seaweed industry and provide a roadmap for the sectoral policy formulation at the state and regional level. The context presented in this brief reflects on the national scale intervention in Malaysia that employed a multi-faceted approach based on fieldwork, key informant interviews, secondary data, and laboratory experiments. It helped to identify the setbacks linked to the decline in production and volatility in the economic sustainability of the industry and to propose strategic recommendations to revive and sustain the value chains in the seaweed industry.

Risks and Challenges in the Seaweed Aquaculture Sector

a) **Lack of coordination in seaweed value chains.**

Given the significant annual revenue of over USD 14 million from seaweed farming since 2008 (Department of Fisheries, Malaysia), the federal government has been supportive of the industry. However, government policies have generally placed more focus on upstream activities, i.e., to increase seaweed production, whilst the marketing and downstream activities have received less attention (Figure 3). The closure of existing carrageenan-processing factories in 2020 can be attributed to the less attractive local market price influencing farmers to sell their

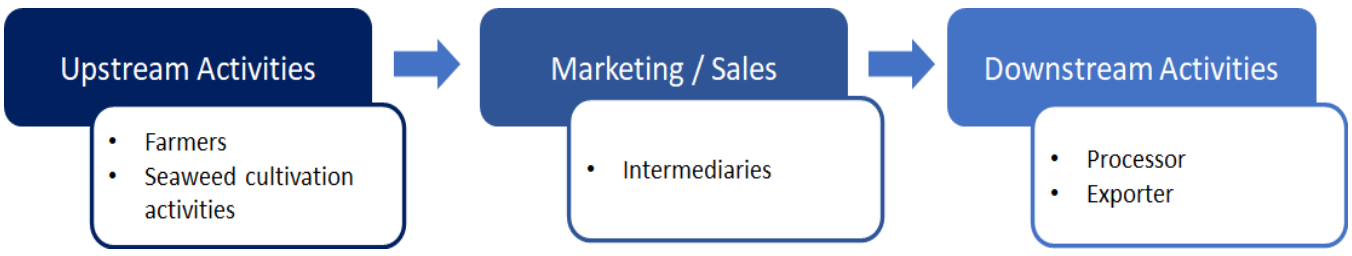

Figure 3. Overview of the Malaysian Seaweed Value Chain

produce to traders from neighbouring countries. The price fluctuation of dried seaweed since 2008 has also caused income instability for the farmers, a scenario that is further exacerbated by inefficient trade practices with the domination of intermediaries, who often hold the power to set a low price between farmers and buyers (Nor et al., 2020). This has reduced profits for small and medium-scale seaweed farmers and discouraged them from further production. Central collecting centers to defray volatility of global market demand and price remain a gap.

b) **Lack of variety in seedlings and cultivars** particularly for *Kappaphycus* and *Eucheuma* (Figure 4) is a major concern (Tan et al. 2021) because biological diversity enhances resilience against disturbance, such as pest and disease outbreaks. A stable supply of healthy seedlings is essential for maintaining the sustainability of the industry. Seaweed supply remains under threat from recurring disease outbreaks of the ice-ice disease (IID) syndrome and epiphytic pest infestation (Figure 5), which are linked to reduced vigor and resilience from long-term usage of the same few cultivars. These outbreaks have caused huge losses to the farmers across the ASEAN region due to reduced yield, overall production volume, and quality of carrageenan.

Climate change is affecting seaweed production. "*Seaweed cultivation is adversely impacted by climate change*" (Kumar et al. 2020)." *The occurrence of "ice-ice" syndrome has been*

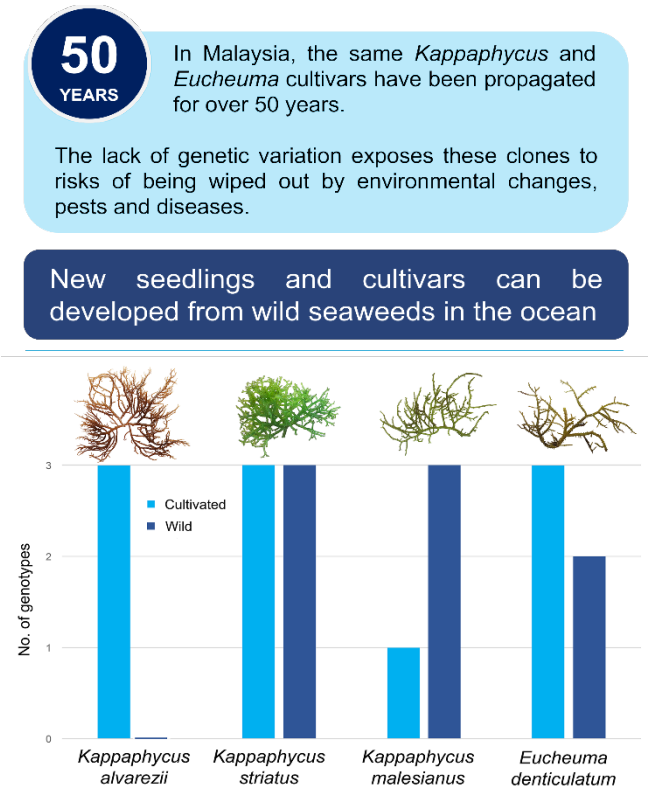

Figure 4. Genetic diversity of *Kappaphycus* and *Eucheuma* cultivars in Malaysia is limited. Source: Lim et al., 2014 & Tan et al., 2021

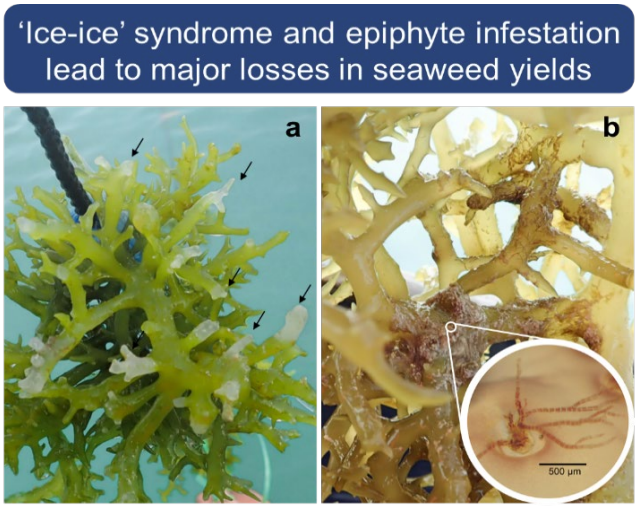

Figure 5. (a) Kappaphycus seaweed affected by "ice-ice" disease syndrome (arrows), which leads to branches breaking off; (b) *Kappaphycus* seaweed with epiphyte infestation and (inset) damage to the seaweed surface at the site of epiphyte penetration.

attributed to unfavorable changes in environmental conditions, which include the rise in seawater temperature and reduced salinity from precipitation" (Ward et al. 2021).

When the seaweeds are stressed and are unable to adapt to these changes, they become more susceptible to secondary bacterial infection.

c) **Lack of implementation of biosecurity measures** in farming practices due to insufficient and conflicting knowledge of risks and management strategies among stakeholders. Good biosecurity lies at the heart of a productive seaweed aquaculture industry (Figure 6). Poor biosecurity and an insufficient supply of healthy seedlings result in heavy production losses from pests and disease. The current national policies and regulations need reform in procedural guidance, including instructions and support for risk mitigation (Kambey et al. 2021a, b). The lack of assistance mechanisms for small-scale seaweed producers to meet international food safety standards and product quality, for wider market acceptability and better selling price, remains a challenge. Small-scale farmers are not aware that in the long run, improving on-farm biosecurity measures has synergistic benefits for their crop production and ocean (marine/coastal) health.

At the regional level, other countries report similar biosecurity challenges: the IID syndrome in eucheumatoid farms can cause the loss of local production up to 40% in the Philippines (Hurtado

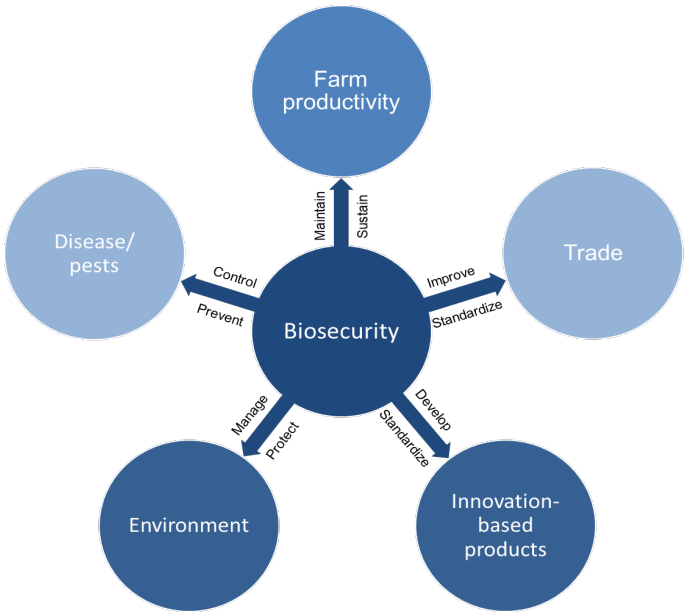

Figure 6. Five main components of the biosecurity approach toward safeguarding the seaweed aquaculture industry in Malaysia.

et al. 2006) and 70-100% in Indonesia (Ward et al. 2021). Most of the eucheumatoids in Southeast Asian countries are being exported as dried seaweeds or carrageenan, but there is increasing interest in the potential for seaweed to provide alternatives to fossil fuel derived materials such as bioplastics, functional foods, and other innovative products. Diversifying into these novel value chains will require seaweed that can be fully certified against national and international standards, to avoid excessive fluctuation in market prices that would discourage future seaweed production.

Four Key Recommendations to Address the Risks and Challenges in the Seaweed Industry

1. Strengthening the Value-Chains

The national budget for the development of the seaweed industry should consider both upstream and downstream activities, with an emphasis on structured and effective marketing and trading of seaweed products, which is currently lacking (Nor et al., 2020).

To sustain the demand for seaweeds, there is a need to widen the horizon from the production of seaweeds solely for carrageenan to diversifying seaweed-based and value-added products, e.g., pharmaceutical products, functional foods, bio packaging materials (bioplastics), and plant biostimulants. This can be done by providing incentives for SMEs or private sectors to develop innovative products and penetrate new markets.

To avoid excessive fluctuations in the prices paid to seaweed farmers, a central collection center could be established either through cooperatives, farmer associations, private companies, or the government to help coordinate the marketing and trading and to monitor seaweed quality.

2. Establish a Centralised Biobank for Indigenous Seaweed Resources.

Investing in a biobank would help support the management and provision of a sustainable supply of healthy seedlings to farmers, especially for recovery from seasonal crop failures.

Strengthening institutional arrangements would facilitate the conservation of indigenous seaweed against loss of biodiversity due to environmental and climate change impacts.

Encouraging the diversification of cultivars through domestication of wild indigenous seaweeds would enhance resilience to pests, diseases, and climate change.

3. Govern Implementation of Biosecurity Measures

To prevent the introduction and spread of pests and diseases at the farm scale, quarantine protocols for imported and local seaweeds of unknown health status need to be strictly implemented by the competent national authority.

Taking stock of exotic and endemic pests or diseases and the respective mitigation measures for reference will enable timely on-farm interventions and raise awareness on reporting pests and disease outbreaks for action and regulatory mechanisms. Establishing an active monitoring system for seaweed aquaculture production zones and developing contingency plans to address future risks and their consequences. This can be achieved through the Good Management Measure Practices and MyGAP certification program. The new findings from Kambey et al. (2021a) on removing the

disease pathways on-farm can potentially reduce the outbreak of the disease.

4. Capacity Building and Support for Research and Development

To encourage the consistent practice of biosecurity measures in farms, periodic training and incentives should be provided to all farmers, including female farmworkers and unregistered farmers (Asri et al. 2021).

Dedicated investment by the government and industry for trait improvement and early detection of pests and disease via joint collaborations with academia should be encouraged and supported via grants and funding for projects and programs.

FACT BOX

The certification program for farmers through the Malaysia Good Agricultural Practices (MyGAP) should have a valuable impact on the industry due to seaweed product standardisation for better recognition in domestic and international markets. This MyGAP system requires regular audits of farm management practices. However, MyGAP is currently ineffective as the certification program is not well implemented and its practices are not being adopted by farmers.

Source: Ministry of Agriculture and Food Industries (MAFI), 2014; https://www.mafi.gov.my/mygap-sektor-akuakultur

Future Directions

Helping the Malaysian seaweed industry address the multiple challenges it faces will involve strengthening the value-chains, boosting policy and technical support for biosecurity, and enhancing the seed supply chain for the producers. Preventing excessive fluctuation in seaweed prices will also help achieve standards of product quality and product diversification to meet both local and export demands. A critical element of this will be establishing biobanks and improving existing farming practices, especially towards disease and pest prevention and management. Such improvements should apply both for upstream and downstream operations of the seaweed value chain and will require careful and concerted implementation by all stakeholders associated with the industry.

The proposed suggestions towards boosting the seaweed aquaculture industry are not only for Malaysia but also applicable for major country producers in Indonesia and the Philippines as similar challenges are faced by their seaweed industry. Across the ASEAN region, the low genetic diversity of seaweed cultivars has resulted from repeated vegetative propagation since the eucheumatoid was introduced as commercial crops in the 1960s. Regionally coordinated biobanking will help maintain

genetic diversity, protect indigenous varieties, and develop superior quality cultivars that can be distributed to farmers. This will support the sustainability of the industry at the regional scale. In addition, good aquaculture practices will contribute to preventing the incidence of diseases and pests, potentially reducing the effects of IID syndrome on a farm by up to 75%.

Finally, regional exchange of experiences and best practices will encourage the creation of fair markets and trade practices and build a diversified and sustainable seaweed industry (Langford, et al. 2020). Overall, in the region, including Malaysia, increasing prioritisation of research towards cost-efficient and innovative products from seaweeds can be a boost for the industry to focus and invest in creating sustainable value chains. Besides the suggestions being highlighted here for the sustainability of the seaweed industry (whether at local, regional, or global level), there is a need for continued improvement of technology, capacity building, and concerted policies to increase the resilience of this industry (Cottier-Cook et al., 2021).

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