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Fish, Farms and Frontiers: What Malaysia's Aquaculture Sector Can Learn from ASEAN Best Practices

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Introduction

Aquaculture is more than just fish farming—it is a lifeline for millions across Southeast Asia. With abundant coastal and inland water resources, ASEAN[1] countries have developed aquaculture not only as a key source of food but also as an important contributor to rural development, poverty reduction and trade[2]. In addition to its economic role, aquaculture supports food and nutrition security in the region as fish remains one of the main sources of animal protein, with average per capita consumption reaching 20.7kg per year in 2022[3].

[1] The Association of Southeast Asian Nations (ASEAN) countries comprise Brunei, Cambodia, Indonesia, Laos, Malaysia, Myanmar, the Philippines, Singapore, Thailand and Vietnam.
[2] SEAFDEC (2022d)
[3] FAO (2024)

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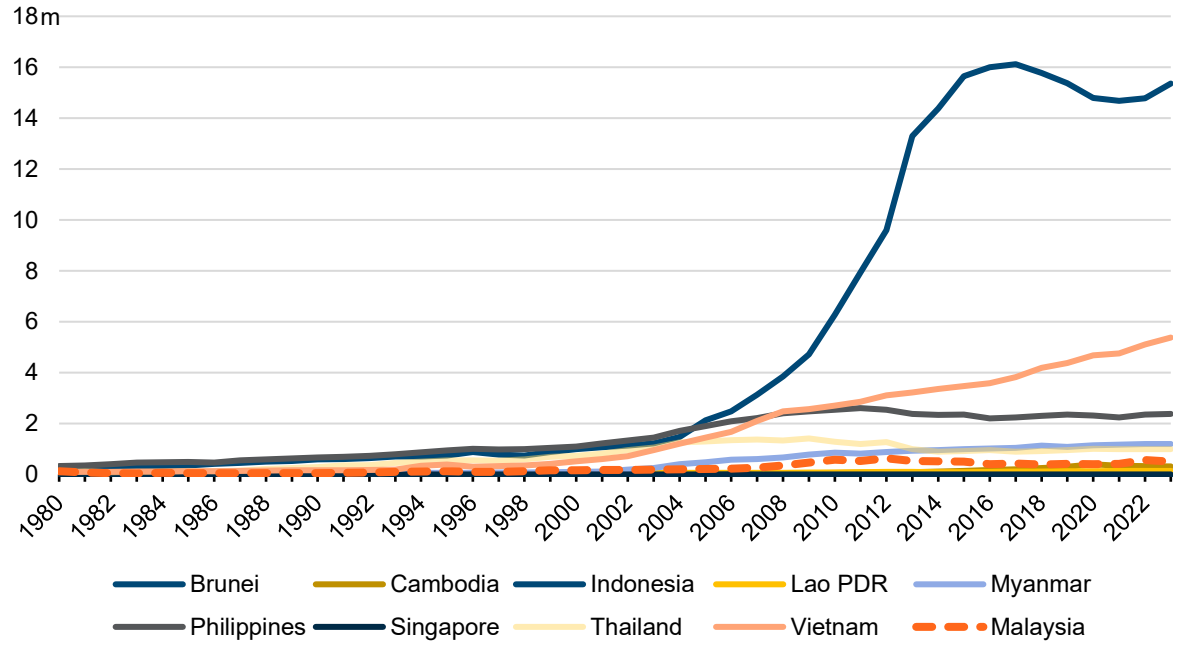
In this context, it is timely for Malaysia to consider how it can further strengthen its aquaculture sector. By examining how other ASEAN countries have expanded production, improved sustainability and supported smallholders, Malaysia can draw practical lessons to inform its own strategies. This article provides a brief comparison of aquaculture development across ASEAN and highlights selected best practices that may be relevant to Malaysia's efforts.

ASEAN Aquaculture Landscape: Production Trends, Main Species and Key Players

The ASEAN region plays a vital role in global aquaculture, accounting for approximately 19% of total global production, or around 26 million tonnes[4]. Between 1980 and 2023, aquaculture output in the region grew at an average annual rate of 6.7%, outpacing the global growth rate of 5.6%[5]. This expansion has been supported by improvements in farming techniques, the expansion of aquaculture areas, increased investment, and effective government policies[6].

Figure 1: Total Aquaculture Production by ASEAN countries (in tonnes), 1980-2023



Source: FishStatJ (2025)

Figure 1 illustrates the growth in aquaculture production across ASEAN countries from 1980 to 2023. Indonesia emerges as the leading producer, contributing large volumes of seaweed, tilapia, catfish and shrimp, supported by a mix of large-scale private enterprises (e.g. integrated shrimp farms) and smallholder operations (e.g. freshwater fish production)[7]. Vietnam follows closely,

[4] FishStatJ (2025)
[5] Ibid.
[6] SEAFDEC (2022d)
[7] Yusuf (1994)

with a strong focus on pangasius farming and shrimp exports. The country employs a range of innovative practices including intensive aquaculture systems and integrated approaches such as rice-fish and rice-prawn polyculture, as well as environmentally friendly mangrove-aquaculture systems[8].

The Philippines is another key player, particularly known for its production of milkfish. Originally dominated by smallholders, the sector has seen increasing commercialisation through the adoption of semi-intensive and intensive systems, supported by public research and private investment[9]. Meanwhile, Thailand's aquaculture sector is heavily oriented toward shrimp production, driven by strong private sector participation, notably from major conglomerates such as the Charoen Pokphand Group[10].

Malaysia and Singapore contribute smaller overall volumes but focus on high-value species such as shrimp and seabass. In Malaysia, aquaculture is supported by both public initiatives—such as Aquaculture Industrial Zones—and private sector investment, alongside ongoing smallholder participation[11]. Singapore, constrained by limited land, relies heavily on high-tech and intensive farming systems[12]. Myanmar, Cambodia, and Lao PDR show emerging potential in freshwater aquaculture, with growth primarily led by smallholder producers[13].

Table 1: Compounded annual growth rate (CAGR) of Aquaculture Production (1980-2023)

Country	CAGR (%)
Cambodia	20.43
Myanmar	15.14
Lao PDR	11.29
Indonesia	10.32
Vietnam	9.73
Singapore	9.32
Thailand	5.60
Philippines	4.69
Malaysia	3.31
Brunei	N/A

Source: FishStatJ (2025); Author's calculation

Between 1980 and 2023, ASEAN's aquaculture sector recorded strong growth across most countries (as shown in Table 1). Cambodia experienced the highest compounded annual growth

[8] FAO (2025b)
[9] SEAFDEC (1995)
[10] Suzuki (2021)
[11] FAO (2025a)
[12] SFA (2024)
[13] SEAFDEC (2022a); (2022b); (2022c)

rate (CAGR) at 20.43%, followed by Myanmar (15.14%), Lao PDR (11.29%), Indonesia (10.32%), and Vietnam (9.73%). Singapore also saw notable growth at 9.32%, while Thailand and the Philippines grew at 5.60% and 4.69% respectively. Malaysia registered a more modest CAGR of 3.31%, and data for Brunei is not available.

Overall, ASEAN's aquaculture sector has demonstrated impressive and sustained growth, though with significant variation across countries. While emerging producers such as Cambodia, Myanmar and Lao PDR have recorded rapid growth, and larger players like Indonesia and Vietnam have maintained strong momentum, others like Malaysia have grown at a slower pace.

Despite this, the region as a whole thrives on species diversity and a wide range of production systems—from traditional smallholder farms to high-tech intensive operations. Each country has pursued distinct priorities, whether in seaweed, shrimp or freshwater fish, but all share a common ambition: to meet rising domestic demand and capture export market opportunities.

This dynamic and uneven growth landscape offers valuable lessons on how different policy frameworks, strategies and innovations have shaped outcomes. As Malaysia seeks to revitalise and strengthen its aquaculture sector, there is much to learn from the varied experiences and best practices of its ASEAN neighbours. The following section explores these in greater detail.

Best Practices in Aquaculture from Selected ASEAN Countries

With growing emphasis on sustainability and self-sufficiency, Malaysia must renew its focus on the fisheries sector – both capture fisheries and aquaculture, as a pillar of national food security and economic growth. Quoting Malaysia's Prime Minister, Datuk Seri Anwar Ibrahim, he states that "the aquaculture industry has the potential to generate lucrative returns for operators while also helping to ensure the country's food security[14]".

Malaysia leads ASEAN in seafood consumption, with an average of 51.03kg per capita, far ahead of aquaculture powerhouses such as Indonesia (40.76kg), Vietnam (40.33kg) and the Philippines (26.56kg) (refer to Table 2)[15]. This high level of consumption, when viewed alongside Malaysia's relatively higher Gross Domestic Product (GDP) per capita (USD11,748.09) as compared to other ASEAN countries, suggests a strong domestic market with the purchasing and consumer appetite to support a thriving aquaculture industry.

[14] Bernama (2025)

[15] It is also important to note that while these countries stand to be some of the top players of aquaculture in the world, this data does not insinuate that they are lacking in terms of aquaculture production, rather it seeks to amplify on Malaysia's own capacity and capability relatively, as these other countries may face other challenges.

Table 2: Fish & seafood consumption per capita and GDP per capita in ASEAN countries in 2022

Country	Fish and seafood consumption per capita (kg)	Gross domestic product (GDP) per capita (USD)
Malaysia	51.03	11,748.09
Indonesia	40.76	4,730.75
Myanmar	40.63	1,158.05
Vietnam	40.33	4,116.39
Cambodia	39.93	2,325.03
Thailand	28.60	6,909.36
Philippines	26.56	3,548.07
Lao PDR	25.11	2,046.40
Singapore	N/A	88,428.70
Brunei	N/A	36,632.93

Source: Our World in Data (2025); World Bank (2025)

Additionally, the aquaculture industry in Malaysia continues to grow, contributing 30% to total fisheries production in 2022[16], with seaweed farming standing out as an exemplary success story in the country's blue economy. As such, the aquaculture industry in Malaysia is now driving the expansion of Malaysia's fisheries sector, as the wild fisheries segment continues to face pervasive challenges such as overfishing, habitat degradation and governance issues[17].

Backed by rich coastal resources and maritime heritage, Malaysia is also well-positioned to further expand its aquaculture industry. High seafood consumption indicates market readiness for premium, traceable products, while its economic capacity allows for greater investment in sustainable, high-tech aquaculture. The current moment presents an opportunity for Malaysia to scale up aquaculture and address the gaps that still hold the sector back[18]. By 2040, rapid urbanisation is predicted to reach 85%[19], insinuating that consumer demands will be reshaped to seek more diversified fish and seafood products. This highlights a space for Malaysia to fill with developing its aquaculture industry.

This aligns with Malaysia's goal of boosting its aquaculture production up to 40% of its total fisheries sector by the year 2030[20] and gives Malaysia the headway it needs to realise its potential as a key player in the global food industry. To do so, it would be a missed opportunity not to take inspiration from other ASEAN countries that play a strong hand in their own aquaculture industries (refer to Table 3).

[16] Obi et al. (2025)
[17] Responsible Seafood Advocate (2025)
[18] Hollis (2024)
[19] Department of Economic and Social Affairs (UN) (2019)
[20] Bernama (2024)

Table 3: Best practices of selected ASEAN countries in aquaculture

Country	Best Practices
Indonesia	• Dipasena's plasma shrimp farm model • Gerakan Pakan Ikan Mandiri (GERPARI) programme
Vietnam	• Integrated mangrove-shrimp farming with an emphasis on organic farms • Integrated rice-shrimp farms
Philippines	• Modular pond systems
Singapore	• Closed Containment Aquaculture Systems (CCAS) • Recirculating Aquaculture Systems (RAS)

Source: Author's own compilation

Indonesia

Indonesia is a global aquaculture powerhouse, ranked second after China[21]. Its success is not solely due to its vast coastline or natural resources but also to targeted strategies and best practices that have driven industry growth.

A key factor is Indonesia's holistic approach to aquaculture, where all stakeholders in the value chain play active roles. The government has launched initiatives such as 'minapolitan'[22] areas, which use fisheries-based economic management to focus on boosting the quality of life of the populace and generating economic gains[23]. These areas often feature large-scale aquaculture farms monitored by relevant ministries.

Another unique practice has been the creation of plasma shrimp farms under Dipasena Citra Darmaja (DCD) in South Sumatra. Here, DCD acts as the "nucleus", providing inputs such as feed, electricity and postlarvae to smallholder farmers (plasma) managing 0.20-ha ponds[24]. The company then buys back the harvested shrimp, creating a mutual profit-sharing cycle[25]. Farmers retain decision-making power over suppliers and sales, while benefiting from stable income and reduced risk[26]. This initiative also led to the formation of the Bumi Dipasena Farmer Cooperative (KPBD), which evolved into village-owned enterprises known as Badan Usaha Milik Desa (BUMDes)[27] – further localising economic benefits and, in effect, creating grassroots-level 'minapolitans'.

[21] Angkasa Putra (2023)
[22] These 'Minapolitan' areas are unique as the government specifically dedicates these areas not solely to farming fish, but also to building up the entire area in terms of its economy, infrastructure, education, services and social development, and centering the aquaculture activites, aiming to create a bountiful community.
[23] Rimmer et al. (2013)
[24] Taw et al. (2007)
[25] Ibid.
[26] M. Yusuf S. Barusman et al. (2019)
[27] Ibid.

While not without challenges, this model fosters collaborative business partnerships, boosts farmer capacity, and strengthens the aquaculture workforce – offering a potential blueprint for Malaysia to adapt.

Indonesia has also championed feed self-sufficiency through the Gerakan Pakan Ikan Mandiri (GERPARI) programme, which reduces reliance on imported feed by promoting local raw materials[28]. Through the Ministry of Marine Affairs and Fisheries, farmer groups like Usaha Sumber Harapan have received feed machines, warehouses, capital and transport to build local feed industries, thus improving income and welfare[29].

A consistent theme in Indonesia's aquaculture strategy is the empowerment of smallholder farmers. Initiatives such as GERPARI and plasma farming encourage participation even at small or backyard scales[30] , making aquaculture more accessible. By highlighting clear incentives and income potential, these programmes have helped expand the sector from ground up, strengthening rural economies and contributing to more inclusive, sustainable growth in aquaculture.

Vietnam

Vietnam has emerged as the world's fourth-largest aquaculture producer since 2005[31], thanks in part to its unique adoption of silvofishery – a sustainable aquaculture method that integrates shrimp farming with mangrove forests. This approach mitigates ecological damage commonly associated with conventional shrimp farming, such as mangrove deforestation, biodiversity loss and increased blue carbon emissions[32].

Silvofishery is a specific cultivation method in aquaculture in which brackish water farms are integrated with existing mangrove forests, allowing mangrove trees to protect ponds from soil erosion during storms and tides[33]. Silvofishery aims to preserve ecological sustainability while reducing the amount of feed and medicines in the ponds, where mangrove forests maintain a high level of water quality. The practice of silvofishery farming is not a new occurrence in Southeast Asia, with countries such as Myanmar and Indonesia implementing it since the 1970s[34]. Vietnam's version stands out for its focus on organic aquaculture, where mangroves often cover more than 50% of pond areas. This low-input model enables smallholder participation and yields premium-priced organic shrimp with minimal environmental impact[35].

Additionally, Vietnam's provincial governments also enforce regulations to maintain Vietnam's forest-to-pond area ratio of at least 40% and uphold a commitment to low feed inputs, fertilisation rates, production and passive water exchange in all of its integrated mangrove-

[28] Asmaida and Rogayah (2019)
[29] Ibid.
[30] Rimmer et al. (2013)
[31] Tri et al. (2021)
[32] Ahmed et al. (2017); Thuy and Luat (2018)
[33] Upadyandaru (2023)
[34] Ahmed et al. (2017)
[35] Ahmed et al. (2017)

shrimp farms[36], emphasising a commitment to organic farming and creating a model of governance that could easily be replicated. This acts as an eco-friendly approach to reducing blue carbon emissions, as a study conducted by Henriksson & Jonell (2014) shows that non-organic farms produce significantly more greenhouse gas (GHG) emissions alongside acidifying emissions as compared to organic farms, thus putting the achievement of Sustainable Development Goals (SDGs) at its forefront.

In addition to silvofishery, Vietnam has practiced a rice-shrimp rotational system since 2001. Unused or inefficient rice fields are converted into seasonal shrimp farms, alternating black tiger shrimp during the dry season and brackish water shrimp during the rainy season[37]. Farmers use tidal flows and culverts to manage water and pests naturally, reducing chemical use[38].

This method is low-risk, low-cost and high-return, often generating greater income than traditional rice farming[39]. Together, these practices demonstrate how Vietnam effectively balances aquaculture development with environmental stewardship and rural resilience – offering scalable models for other countries, including Malaysia, to consider.

Philippines

The Philippines is globally recognised for its milkfish (bangus) farming, with milkfish being one of the most affordable and accessible sources of animal protein in the country[40]. To increase production, the Philippines developed one of its key aquaculture best practices: the modular pond system[41].

This system uses three adjacent ponds, each representing a different production stage[42]. Fish are moved between ponds depending on natural food availability and pond conditions, which helps maintain steady growth rates, survival and disease control[43]. Each pond undergoes uniform preparation, using the lablab or plankton method[44] to promote natural food growth and adjusting pond conditions for optimal efficiency[45].

Whenever natural food in a pond becomes limited, the stocks are moved to a newly and freshly prepared pond[46]. This transition drastically improves survival and growth rates, ensures

[36] Jonell and Henriksson (2014)
[37] Tri et al. (2021)
[38] Phuc (2023)
[39] Phuc (2023)
[40] Tacio (2010)
[41] Agbayani et al. (1989)
[42] Baliao et al. (1999)
[43] Agbayani et al. (1989)
[44] According to a SEAFDEC report by Lijauco et al. (1979), the lablab or plankton method are known as two popular natural food-rearing methods used in nursery pond operations, where the lablab method involves cultivating bottom-growing algae, small plants and animals (zooplankton), whereas the plankton method relies on suspended micro-organisms (phytoplankton) in the water to act as a food source.
[45] Agbayani et al. (1989)
[46] Ibid.

consistent food availability and reduces early-stage disease risk. Stocking fish seeds also further facilitates acclimatisation and adaption, both critical for population success[47].

The system combines enhanced fertilisation strategies: chicken manure at 1t/ha/crop, inorganic fertilisers at 150-200kg/ha/crop, and urea in a 1-2:1 ratio[48]. This layered method supports strong natural food chains while keeping input costs manageable. Harvesting is done through the traditional "pasulang" method, where fish are guided against water currents for easier collection and then preserved via ice-freezing[49]. Farmers benefit from better control over environmental variability, especially temperature, which enhances survival rates.

Overall, the modular pond system is a low-cost, high-efficiency approach that raises productivity while equipping farmers with critical skills in stock management and pond monitoring. It offers a scalable, sustainable model for improving aquaculture outcomes in the region.

Singapore

Singapore is a relatively small country which imports more than 90% of its food[50], making it highly vulnerable to global supply disruptions. Despite its limited land, sea space and suboptimal water conditions[51], Singapore has responded by embracing high-tech aquaculture to boost self-sufficiency.

Two of its key best practices are the Closed Containment Aquaculture Systems (CCAS) and the Recirculating Aquaculture Systems (RAS)[52]. CCAS allows for recycled, high-quality water control, shielding fish from environmental risks such as algal blooms and enabling production in previously unsuitable areas[53]. Some farms are even experimenting with hybrid models that combine the benefits of CCAS and traditional open net-cage farming systems[54].

RAS enables full environmental control for breeding sensitive species, using advanced filtration to recycle water and remove suspended matter. These setups support species-specific farming, regardless of Singapore's natural climate constraints[55]. Additionally, Singaporean aquaculture companies are also integrating AI and IoT into their operation, as listed in Table 4 below:

[47] Abdul Haris Sambu et al. (2024)
[48] Agbayani et al. (1989)
[49] Baliao et al. (1999)
[50] SFA (2024)
[51] Shen et al. (2021)
[52] SFA (2024)
[53] Ibid.
[54] Ibid.
[55] Ahmed and Turchini (2021)

Table 4: Incorporation of AI in Singapore's aquaculture farms

Type of Farm	Company	Usage of AI/Tech
Sea-Based Farm	Singapore Aquaculture Technologies (SAT)	• Utilises CCAS with automated data collection, analytics, and AI • Employs floating recirculating systems to avoid direct exposure to seawater
	The Fish Farmer (TFF)	• AI-based fish counting • Usage of IoT to monitor dissolved oxygen levels in tanks
Land-based Farms	Blue Ocean Aquaculture Technology (BOAT)	• Vertically integrated RAS with CCTV monitoring • IoT sensors and nano-bubble technology for space optimisation • AI functions to treat water and monitor oxygen levels

Source: SFA (2024)

Singapore Aquaculture Technologies (SAT) leads with the country's first AI-powered smart fish farm, where automated video monitoring, data analytics and solar energy (powering 40% of the farm) streamline everything from disease detection to biomass estimation[56]. This "Aquaculture 4.0" approach enhances efficiency and sustainability while aligning with SDG targets[57]. As Singapore continues to strengthen its R&D ecosystem, it is positioning itself as a regional hub for tropical aquaculture technology, showing how innovation can overcome physical limitations and redefine modern fish farming[58].

Conclusion

As Malaysia seeks to strengthen its aquaculture sector, there is value in looking to neighbouring ASEAN countries for inspiration. Indonesia, for instance, offers lessons in inclusive business models and efforts toward feed self-sufficiency. Vietnam demonstrates how integrated farming systems can support environmental sustainability, while innovations from the Philippines—such as modular pond systems—highlight ways to improve yields and build resilience. Even in space-constrained Singapore, technology is opening up new possibilities for aquaculture.

Malaysia already has several advantages: strong domestic demand for seafood, relatively high purchasing power and an aquaculture industry with growing public and private sector involvement. However, slower growth rates and ongoing production challenges point to the need for more targeted strategies. Learning from regional experiences could help inform efforts to empower smallholders, support sustainable intensification and strengthen the local production of key inputs.

[56] Ahmed and Turchini (2021)
[57] BluCurrent (2020)
[58] SFA (2022)

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