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Asian Shrimp: Steady Supply in 2025

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Cooked vannamei shrimp from YHL Desaru, Malaysia, p14.

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Zuridah Merican

2026: Prognosis and wish list

The global economic outlook shows resilient growth with Asia Pacific leading in stability while the US is showing a K-shaped growth i.e. diverging growth. The EU will face uneven growth from its constituent countries. China, while still plagued by its weak property market, is expected to show robust manufacturing growth.

How will this affect aquaculture and the prognosis for 2026? Here are the top 10 salient points which includes AAP's wish list.

1. The global aquafeed demand is likely to show modest growth in 2025 and 2026 after a 4% decline in 2024 (Alltech Global Feed Survey) and this will be pushed by high value aquaculture species.

2. In terms of feed ingredients, fishmeal prices will remain firm while soybean meal and corn-based ingredients will be soft. This leads to stable feed prices while giving alternative ingredients breathing space as they benchmark their prices versus fishmeal. Furthermore, fishmeal supply is forecasted by Rabobank to be short as early as 2027.

3. Aquafeeds will be differentiated by its sustainability credentials starting in the EU and followed by the US. As part of the value chain, Asia Pacific is starting to adopt this via its exports to the EU market. The wish is for the shrimp sector to adopt more functional feeds as a tool to mitigate stress and disease challenges.

4. The shrimp trade still faces an oversupply risk due to a continued increase in Ecuador's exports while tariffs in the US can cause price swings. China's stagnant demand limits the upside potential. The shrimp sector must invest in productivity and move away from just cost saving. This requires a change in mindset and in Asia, it will be the next generation farmers leading this charge.

5. Asia must find the right balance in shrimp stocking density for ROI. Ecuador has low density culture and increases production through more cycles per year via nurseries and 3-phase farming. This strategy allows for increasing volumes without challenging the carrying capacity and risking disease outbreaks. Asia, on the other hand, has adopted partial harvesting to control biomass as shrimp gain in size. Here, it is the management of densities without challenging the carrying capacity during each cycle. These strategies are not mutually exclusive. So why not do both?

6. Another wish is for Asia to adopt better feeding systems. Unlike fish where one can observe feeding to satiation, over feeding is still common in shrimp. Excess feed is not only money lost but also increases sludge buildup and *Vibrio* levels, leading to disease risks again.

7. Marketing is still a weak link in the supply chain for both tilapia and pangasius. There are two distinct markets and sizes for tilapia, and the product must be fit for the local market or for export. The cold chain and post-harvest logistics are crucial for the local market while zero "off flavour" and processing capability are critical for export. Vietnam's pangasius supply chain is fine-tuned but still lacks marketing to move up the 'white fish' ladder. Conversely, Regal Springs has positioned tilapia into the British 'fish and chips' offering, ready for the anticipated drop in ground fish catches.

8. Finding the Asian salmon remains elusive. The Asian seabass (barramundi) does not have the economies of scale to attract investments. It is not feasible for a single country to have the competitive edge along the whole value chain. The better model is for various countries to work together, each focusing on its strength and specialising in a sector to develop an integrated ecosystem. Easier said than done?

9. Tariffs and the supply chain can alter global competitiveness and the markets. How will the front loading of imported stock in 2025 affect the carry-over to 2026 in the US? For shrimp, it is forecasted that a 10% increase in price to the consumer will result in a drop of 3.5% consumption in the following 12 months (GSF 2025).

10. Seafood is the largest traded food protein in the world because producing countries are not the consumers. China, India, and Southeast Asia together represent half of the world's population. With increasing GDP per capita in these regions, developing the local market is the way to go. According to S&P Global Commodity Insights, rapid changes are occurring in Asian consumer markets for food and beverages, spurred by rising incomes, urbanisation, and an expanding middle class. India is no longer seen as a vegetarian nation with low spending power. A small uptick in per capita shrimp consumption can create a large demand.

If you have any comments, please email: zuridah@aquaasiapac.com

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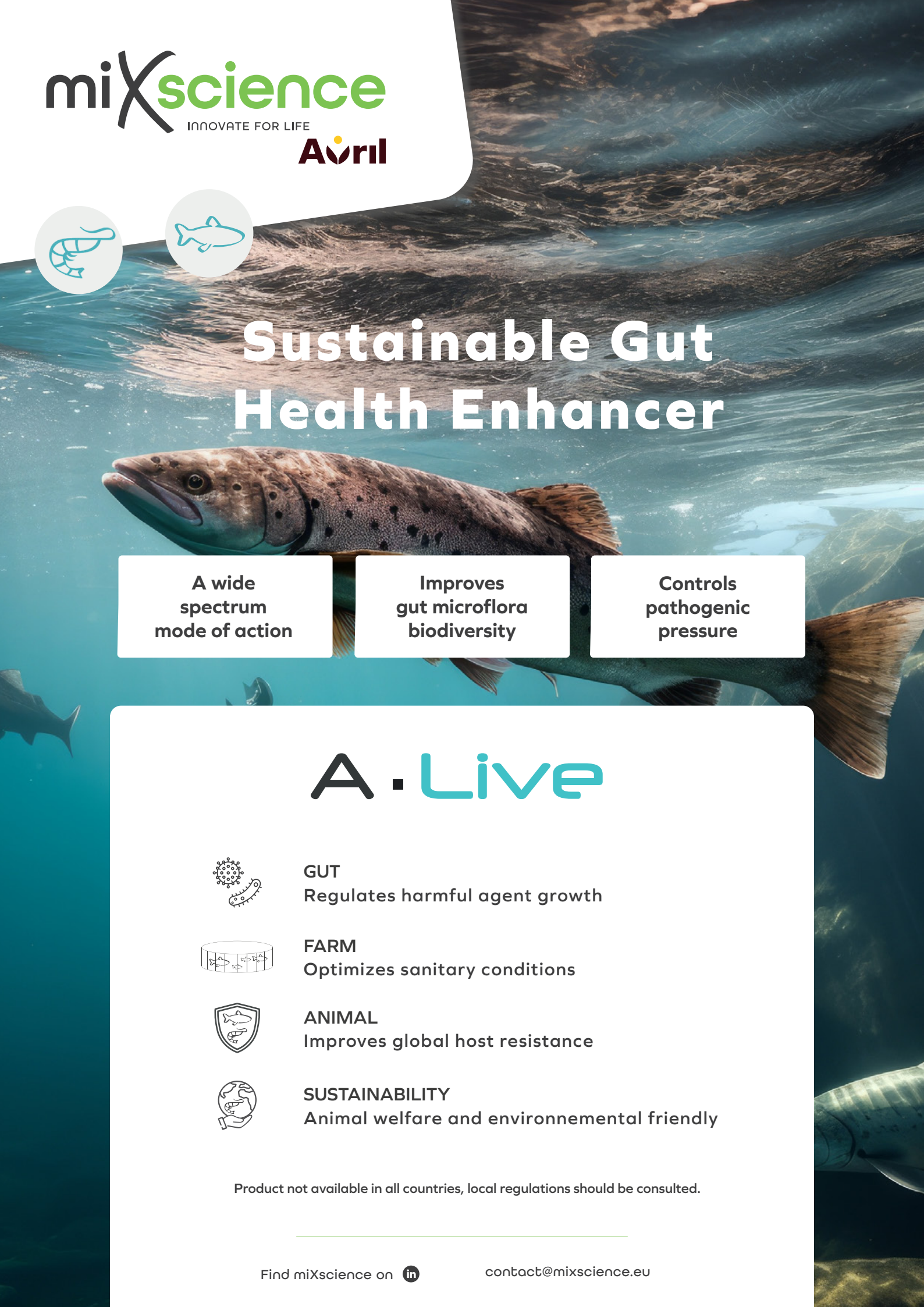

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SEATA to boost tilapia value chain collaboration and innovation

The launch of SEATA at Tilapia 2025 with Lukas Manomaitis, USSEC (left) and steering committee members (from second left), Jessica Kaye Turner, Nam Sai Farms, Thailand; Rudolf Hoeffelman, Regal Springs, Indonesia; Florendo Jon Juico Jr., The Philippine Tilapia Stakeholders Association (PHILTILAPIA) and Dinh Xuan Lap, ICAFIS, Vietnam. Photo credit: Infofish.

In October 2025, the U.S. Soybean Export Council (USSEC), through its Regional Agricultural Promotion Program (RAPP) led a group of regional tilapia associations on the first step to form the Southeast Asia Tilapia Association (SEATA).

The vision for SEATA is a regional, pre- competitive platform designed to strengthen collaboration, competitiveness, and innovation across the tilapia value chain. Representatives from four of Southeast Asia's leading tilapia producing countries (Indonesia, Philippines, Thailand and Vietnam) met in Singapore to start off this landmark initiative. According to USSEC, this meeting marks the most coordinated regional effort to date to unify Southeast Asia's tilapia sector under a shared strategic framework.

In November, SEATA was formally introduced to the broader global tilapia community at the 5th INFOFISH World Tilapia Trade and Technical Conference & Exhibition 2025 (TILAPIA 2025), held in Bangkok, Thailand. The idea was to seek public comment and input on its eventual formation.

On stage were members of the steering committee, tasked with shaping its scope, governance structure, working groups, and membership pathways. They were Jessica Kaye Turner, Assistant Managing Director, Nam Sai Farms Co., Ltd. Thailand; Rudolf Hoeffelman, President Director, Regal Springs, Indonesia; Florendo Jon Juico Jr., President, The Philippine Tilapia Stakeholders Association (PHILTILAPIA); and Dinh Xuan Lap, Deputy Director at ICAFIS (International Collaborating Centre for Aquaculture and Fisheries Sustainability), Vietnam. Lukas Manomaitis, East Asia Aquaculture Lead at USSEC, made the case for a Southeast Asia regional grouping.

"To date, there isn't any global tilapia organisation or regional tilapia groupings, so SEATA might be the first model for the setup of a type of association to keep growing the market for the tilapia," said Manomaitis. "If tilapia wants to move to the next level in terms of markets, it makes sense to organise the industry to address common issues that impact most, if not all, producers and other stakeholders in the tilapia industry."

While Thailand is not yet a major exporter of market-size tilapia for consumption, it has a strong reputation for producing high-quality tilapia fry, which are exported worldwide. In addition, Thailand has strong processing capacity, high food-safety standards, and proximity to key regional markets. SEATA provides Thailand with an important platform to further scale and diversify its tilapia exports.

Turner said that the value of a regional tilapia association lies in turning shared goals into practical collaboration. "When countries align on clear objectives, the association can move beyond being symbolic and deliver real outcomes—through knowledge sharing, coordinated action, and initiatives that help stakeholders across the value chain meet international standards and access new markets. This kind of cooperation is essential for building a strong and sustainable future for tilapia in Southeast Asia."

There is a potential for SEATA to be the umbrella organisation for country-wide associations where they exist while open to individual and company memberships. The Tilapia Association Thailand or TAT is expected to be the national counterpart representing Thailand within SEATA. Indonesia established the Indonesia Tilapia Association (ATI or *Asosiasi Tilapia Indonesia*) in 2023 in Bandung, bringing together farmers, hatcheries, processors, and exporters. PHILTILAPIA represents tilapia stakeholders in the Philippines. In November, Vietnam's tilapia businesses agreed to establish the Council of VASEP Tilapia Producers and Exporters (VASEP Tilapia Council), under the Vietnam Association of Seafood Exporters and Processors (VASEP).

A sustainable, inclusive growth path for Southeast Asia's tilapia sector

The launch at Tilapia 2025 provided an opportunity to present SEATA's founding vision and strategic objectives and to engage stakeholders across the global tilapia value chain—including producers, feed companies, genetics providers, processors, exporters, and policymakers. The group highlighted how coordinated action can strengthen export readiness, improve product quality, and support sustainable growth. With rising demand for responsibly farmed fish, SEATA aims to elevate the region's reputation and market influence while seeking sustainable production and expansion.

Together, Southeast Asian countries account for 1.68 million tonnes of Asia's 4.21 million tonnes of tilapia production. Despite this scale, there is currently no regional or international tilapia industry group. The sector lacks a unified voice, shared standards, and coordinated strategy—gaps that SEATA aims to fill.

TIF "Je Dois Faire" Award at Tilapia 2025

Amorn Luengnaruemitchai, Managing Director of Manit Genetics receiving the TIF "Je Dois Faire" Award at Tilapia 2025 from Mathieu Pinkers, President of the Tilapia International Foundation. Also in the photo are Professor Kevin M. Fitzsimmons, University of Arizona and Infofish Director in Malaysia, Gemma Meermans Matainaho (second left). Photo Credit: Infofish

On 4 November 2025, the Tilapia International Foundation (TIF) presented the Mgr. J.D.F. Heine – "Je Dois Faire" Award to Amorn Luengnaruemitchai, Managing Director of Manit Genetics (Thailand), during ISTA 13 and the INFOFISH TILAPIA 2025 event in Bangkok. The biennial award, which includes an official certificate and a financial grant, recognises individuals or organisations that have made outstanding contributions to the development of the aquaculture sector.

Amorn, a graduate of Kasetsart University and the Asian Institute of Technology, has been a leading pioneer in tilapia breeding and genetics for more than two decades. His work is highly valued by fish farmers throughout Thailand. In his presentation, Amorn described Thailand's tilapia industry as one shaped by the familiarity of Thai consumers with the fish. While tilapia is widely consumed as an accessible, affordable, and ubiquitous protein, it is not yet viewed as an aspirational product.

The industry is dominated by smallholders (70%), followed by cooperatives (20%), which benefit from bulk purchasing of inputs, and integrators (10%). Intensive farms can produce up to 40 tonnes/ha. Most operations are family-run businesses intended to be passed on to the next generation—much like Manit Group, which celebrates its 50th anniversary this year, with Amorn representing the second generation.

He outlined several challenges faced by small-scale farmers, including weak bargaining power when selling through middlemen, high feed and energy costs, and limited access to finance. He also noted the slow adoption of technology, such as vaccines, which many farmers still view as a cost rather than an investment.

Amorn highlighted the relevance of Thailand's Sufficiency Economy Philosophy (SEP) in shaping the country's aquaculture sector. Applied to tilapia farming, SEP encourages farmers to produce at optimal levels and costs, avoid over-investment, and respect seasonal and environmental constraints. Amorn believes this philosophy has enabled Thailand's tilapia sector to grow steadily, sustainably, and with a strong sense of balance.

"Thailand's tilapia story is not just about production volumes or market share. It is about the power of enough — a national ethos that values resilience over rapid expansion, and wisdom over short-term gains."

Through this Award, TIF also honours the legacy of its founder, Mgr. J.D.F. (Father Jan) Heine, whose lifelong commitment to food security and the fight against hunger and stunting continues to inspire sustainable tilapia aquaculture worldwide. TIF is a Netherlands-based foundation focused on building tilapia ponds and supporting small-scale aquaculture projects in Asia, Africa, Latin America, and the Caribbean. Its mission is to combat hunger, malnutrition, and stunting through sustainable tilapia farming. The motto "Je Dois Faire" is a call to act for food security.

US and Vietnam: A new premium shrimp sub-brand

CenSea, one of the largest frozen seafood importers and distributors in the US, has launched CenSea Reserve, a new premium shrimp sub-brand designed to set a higher benchmark for taste, texture, and premium performance across foodservice and retail channels.

Unlike conventional supply chains, Reserve shrimp are raised in ponds with carefully balanced salinity ocean water which closely mirrors their natural habitat. Each shrimp is delicately harvested and swiftly transported with a live oxygen supply from farm to factory. They are then stunned using advanced Japanese-inspired techniques and processed swiftly with minimal water contact to lock in maximum freshness and a pristine texture.

"CenSea Reserve is the outcome of asking a very direct question: what does premium actually mean, and how do you make it repeatable at scale," said Nate Torch, Co-President, CenSea. "The Reserve brand was built end to end, from how shrimp are raised to how they are frozen fresh at catch, with the goal of delivering a consistently superior product. It's for those discerning chefs and buyers who demand verifiably sustainable, fully traceable shrimp, with top-tier culinary performance to differentiate their portfolio in a crowded market."

CenSea Reserve is produced in partnership with Minh Phu Seafood Corporation, the world's largest vertically integrated shrimp producer and processor. Founded in 1992 and headquartered in Vietnam, Minh Phu is globally recognised for its leadership in responsible aquaculture and processing excellence.

"Minh Phu has always focused on farming and processing shrimp in ways that respect both nature and product quality," said Le Van Quang, CEO, Minh Phu Seafood Group. "CenSea Reserve reflects that shared philosophy. We are proud to produce this line using our breakthrough Minh Phu Bio (MPBio) 5-in-1 technology. This system integrates five core pillars: simulating the natural ocean environment; raising shrimp in balanced-salinity seawater, which is controlled by utilising seawater pipelines leading from offshore directly to the farm; live transport to the plant; Japanese-inspired Ikejime stunning; and immediate processing. The result is shrimp that delivers exceptional flavour, sweetness and a distinctive texture."

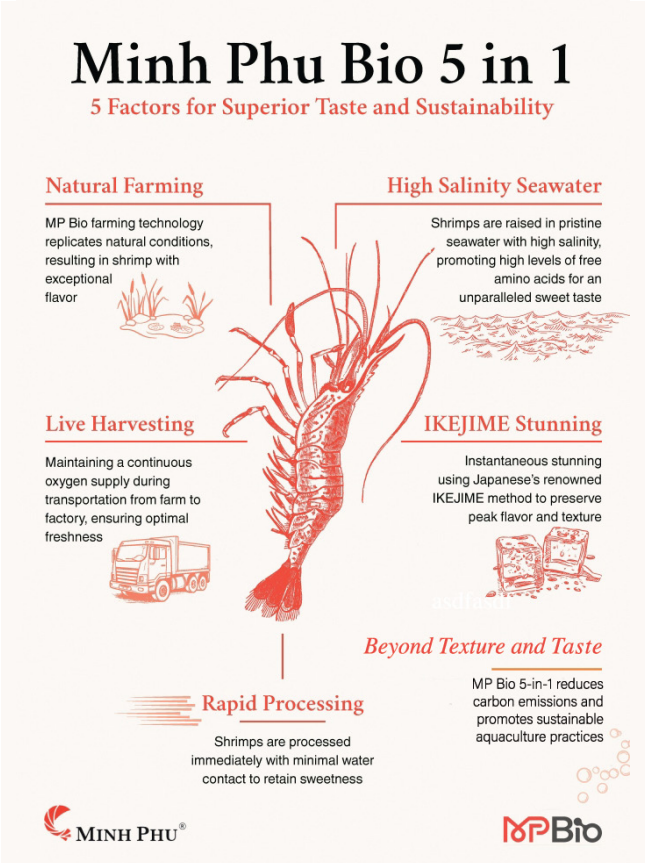
Elevating shrimp beyond commodity status

CenSea Reserve represents the company's most deliberate investment yet in elevating shrimp beyond commodity status. The launch also marks the first new brand introduced since CenSea became part of the Captain Fresh Group in early 2024, reflecting a shared ambition to build differentiated, value-led powerhouse of seafood brands backed by deep supply chain technology expertise.

"The launch of CenSea Reserve is a strategic move to disrupt the premium segment by moving beyond commodity claims. By leveraging Minh Phu's unique aquaculture and processing breakthroughs, we are not just adding a SKU; we are creating a new gold standard," said Jeff Stern, Co-President, CenSea.

CenSea Reserve shrimp contain no added phosphates or antibiotics and are fully traceable from source to shelf. Committed to the future of the industry, the product is BAP-certified and features eco-friendly, biodegradable packaging. The new sub-brand is positioned for chefs, foodservice operators, and retailers who view shrimp not as an interchangeable input, but as a defining element of the eating experience. "This isn't an everyday shrimp," Torch added. "CenSea Reserve is prestige on a plate."

CenSea Reserve is available nationwide across select foodservice and retail partners beginning this quarter, with initial offerings, including raw, easy-peel shrimp from live vannamei in 8/12, 13/15, and 16/20 count, and raw, easy-peel shrimp from live black tiger in 13/15 and 16/20 counts.



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Relative sensitivity of hatchery profits to feed price and survival: Are lower cost feeds a false economy?

By Peter Van Wyk

Since early 2022, a global oversupply of frozen shrimp and high inventory levels have placed extreme downward pressure on shrimp prices. The resulting decline in farmgate prices has cascaded through the supply chain, leading to historically low prices for postlarvae (PLs). In Latin American markets, PLs are now selling for as little as USD2.00/1,000 PLs, while prices in Asia are slightly higher.

Feed price vs quality: An economic balancing act

However, as profit margins shrink, hatchery managers are under increasing pressure to reduce operating costs. In the short run, most major cost categories (management, labour, utilities, depreciation, and even the production of nauplii and algae) are largely fixed. Once stocked, broodstock must be maintained and the overhead is tied to facility capacity. These costs cannot be reduced in the short run. In contrast, feed costs represent a true variable expense: the price and quality of formulated feeds can be adjusted from one cycle to the next. With few other options, many hatcheries have turned to lower-priced feeds to reduce expenses.

While this strategy appears rational, there are trade-offs when higher-quality, more expensive feeds are replaced with lower-priced, lower-quality feeds. Feed quality directly affects larval survival and growth. Larval survival, in turn, determines hatchery revenues by changing the number of PLs available for sale. It also affects the average fixed cost per PL. With lower survival, total fixed costs are spread across fewer animals, increasing the cost per PL produced. Thus, the overall economic impact of switching to cheaper feed depends on the balance between the direct savings from lower feed prices and the combined effects of reduced survival on both revenues and fixed costs per PL.

The objective of this article is to analyse the relative sensitivity of hatchery profits to changes in feed price and survival as a function of PL sales price.

Modeling approach and assumptions

To evaluate these relationships, a typical shrimp hatchery budget (Table 1) was used to model the effects of changes in average supplemental feed price and survival on hatchery profitability. The hatchery budget was based on a typical operation producing 100 million PLs per month. Costs for nauplii, *Artemia*, and supplemental feed were based on typical industry values. All remaining expenses were grouped as *Overhead & Other Costs* and estimated by assuming a total production cost of USD1.50/1,000 PLs, typical for large hatcheries. Overhead was calculated as total production cost minus the sum of nauplii, *Artemia*, and supplemental feed costs. All costs are expressed in USD/1,000 PLs.

Sensitivity analyses

Profit sensitivity to feed price and survival was examined through a series of sensitivity analyses. Profits were recalculated after changing each variable in 1% increments, while keeping all other parameters constant. Additional analyses were conducted at two PL sales prices (USD3.00 and USD2.00/1,000 PLs) to show how PL price influences sensitivity to feed price and survival. The baseline scenario assumed a monthly stocking of 182 million nauplii, 55% survival, and an average supplemental feed price of USD25/kg.

Production & Feeding Assumptions	Units	Value
Nauplii stocked per month	million nauplii	182
Survival to PL12	%	55%
Days to harvest	days	19
Supplemental feed usage rate	kg feed/million PLs	5.00
Artemia cyst usage rate	kg cysts/million PLs	2.00
Production Inputs and Outputs/month	**Units**	**Value**
PLs harvested	million PLs	100
Nauplii stocked	million nauplii/month	182
Supplemental feeds /month	kg/month	500
Artemia cysts/month	kg *Artemia* cysts/month	200
Overhead & other inputs	months	1 month
Prices	**Units**	**Value (USD)**
PL sales price	USD/1,000	3.00
Nauplii	USD/1,000	0.27
Supplemental feeds (average)	USD/kg	25.00
Artemia cysts	USD/kg	65.00
Overhead & other inputs	USD/month	75,409
Financial Results (per month)	**Units**	**Value (USD)**
Revenues from PL sales	USD/month	300,000.00
Nauplii cost	USD/month	49,091
Supplemental feed cost	USD/month	12,500
Artemia cysts costs	USD/month	13,000
Overhead & other inputs	USD/month	75,409
Total costs	**USD/month**	**150,000**
Total profits	**USD**	**150,000**
Financial Results per 1000 PLs sold	**Units**	**Value (USD)**
Revenues per 1,000 PLs	USD/1,000 PLs harvested	3.00
Naupli cost/1,000 PL	USD/1,000 PLs harvested	0.49
Supplemental feed cost/1,000 PL	USD/1,000 PLs harvested	0.13
Artemia cysts costs/1,000 PL	USD/1,000 PLs harvested	0.13
Overhead & other costs/1,000 PL	USD/1,000 PLs harvested	0.75
Total costs per 1,000 PL	**USD/1,000 PLs harvested**	**1.50**
Profit per 1,000 PL	**USD/1,000 PLs harvested**	**1.50**

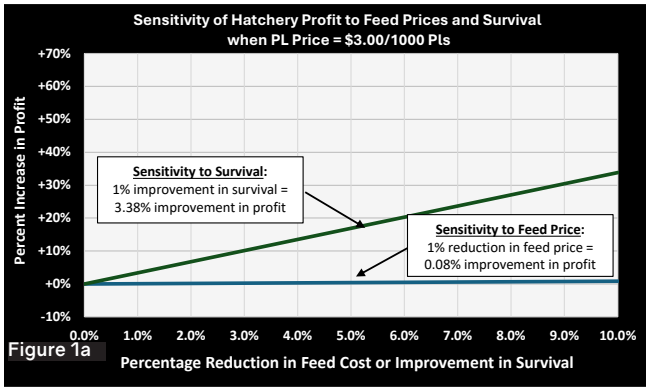
Table 1. A typical shrimp hatchery budget used to evaluate how changes in feed price and survival affect profitability.

For the feed-price sensitivity analysis, profits were recalculated after reducing feed price in 1% increments while holding all other variables constant. For the survival sensitivity analysis, profits were recalculated after increasing survival in 1% increments, again keeping all other values fixed. Both analyses were performed at PL prices of USD3.00 and USD2.00/1,000 PLs to quantify how PL market price affects the sensitivity of profitability to feed price and survival.

Results of the sensitivity analyses are shown in Figure 1. Each graph presents the relationship between hatchery profits and changes in a single variable (feed price or survival) at two PL sales prices. For each analysis, profits were recalculated after changing the selected variable in 1% increments while holding all other parameters constant. These slopes show how profits respond to changes in feed price or survival under different market conditions.

Survival, not feed price, drives profitability

The results clearly show that profits are far more sensitive to changes in survival than to changes in feed price. At a PL price of USD3.00/1,000 PLs (Figure 1a), a 1% reduction in feed price increases profit by only 0.08%, while a 1% improvement in survival increases profit by 3.38%. When PL price declines to USD2.00/1,000 PLs (Figure 1b), a 1% reduction in feed price increases profit by 0.26%, whereas a 1% improvement in survival increases profit by 6.68%. The steeper slopes at the lower PL price reflect shrinking margins, where a given change in cost or revenue produces a proportionally larger change in profit.



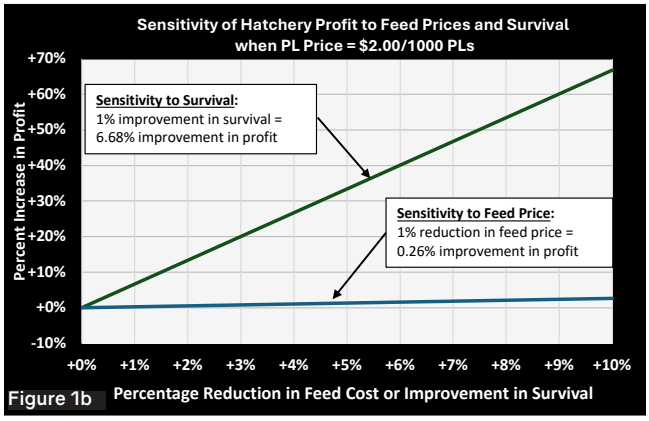


Figure 1. The sensitivity of hatchery profits to reductions in feed price and improvements in survival at PL prices of USD3.00/1,000 PLs (1a) and USD2.00/1,000 PLs (1b). Slopes show the percent change in profit for each 1% reduction in feed cost or 1% increase in survival. As PL price declines, profitability becomes much more sensitive to changes in survival.

An examination of a typical hatchery cost structure (Figure 2) helps explain why feed price has only a modest effect on profitability. Under the low-feed-price scenario, fixed costs (overhead and other costs plus nauplii) account for just over 80% of total cost, while supplemental feed cost represents only about 6.7%.

A 50% increase in feed price has little effect on hatchery cost structure - fixed costs still exceed 80% of total cost, and supplemental feed cost remains under 10%. In this example, a 50% increase in supplemental feed cost increases total cost by only 3.3%. Since feed makes up such a small share of total cost, even large price changes have minimal impact on profitability.

Survival, on the other hand, affects both sides of the profit equation. Revenues are directly proportional to the number of PLs harvested, so a 1% increase in survival produces a 1% increase in revenue. However, the effect extends beyond revenue. Since most costs for nauplii,

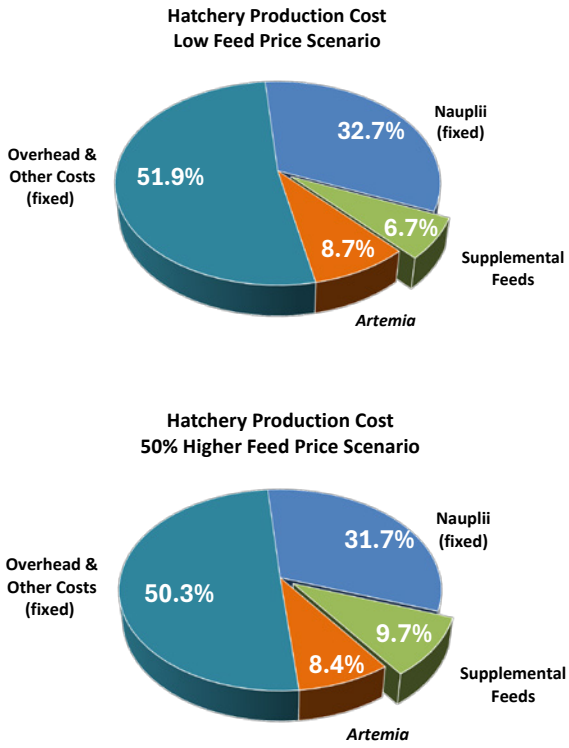


Figure 2. Distribution of major cost categories in shrimp hatchery production under low and high feed price scenarios. Even with a 50% increase in feed cost, supplemental feeds represent under 10% of total cost, while fixed costs (overhead and other costs plus nauplii) remain over 80%.

Artemia, and overhead and other costs are fixed within a production cycle, higher survival spreads those costs over more PLs, lowering the fixed cost per PL produced. The combined effect of increased revenue and reduced unit cost amplifies the profit response to changes in survival, as shown by the steeper slopes in the survival sensitivity graphs in Figure 1.

Taken together, these results demonstrate why reductions in feed prices yield only small gains in profit, whereas improvements in survival produce large increases. Feed prices influence only a small component of total cost, whereas survival simultaneously increases revenue and decreases unit cost by diluting fixed expenses. The analysis also highlights the vulnerability of hatchery profitability to survival losses under low market prices: as margins tighten, small changes in survival have disproportionately large economic impacts.

It should also be noted that the feed-price analysis assumes survival remains constant when feed prices change. Note that this assumption is seldom true in practice. Lower-priced feeds often achieve their price advantage by compromising ingredient quality, nutrient stability, or digestibility, all of which can reduce larval performance. Consequently, the actual profit response to feed-price reductions is likely smaller than the theoretical estimates presented here.

How feed quality influences survival

While hatchery profits are far more sensitive to survival than to feed price, the key question is how feed quality affects survival.

High-quality supplemental feeds support higher survival because they provide balanced and highly digestible nutrition that promotes fast, healthy development. Premium marine ingredients, such as refined fish meals, krill meal, squid meal and fish protein hydrolysates,

supply easily absorbed proteins, balanced amino acids, and essential fatty acids that are important for early growth, organ development and immune function. Natural attractants help larvae begin feeding quickly and consistently, improving digestion and growth.

As a result, larvae develop into larger and stronger postlarvae that tolerate stress better and are less susceptible to disease. This leads to higher survival in the hatchery and better performance later in nursery and grow-out, where most profits are made.

Survival is further enhanced when diets deliver the nutrients larvae require without large excesses. Highly digestible ingredients improve nutrient assimilation, reducing waste production and helping control ammonia, a common chronic stressor in larval systems. Low ammonia and stable water quality strengthen health and reduce background mortality. In contrast, many lower-quality diets are over-formulated to compensate for ingredients with inferior nutrient profiles. These excesses generate more waste, degrade water quality, slow growth and increase mortality risk. They may also raise water-treatment requirements and operating costs.

In short, high-quality diets provide the balanced nutrition, stable water conditions and stronger disease resistance required for consistently high survival, making feed quality a key driver of long-term hatchery success.

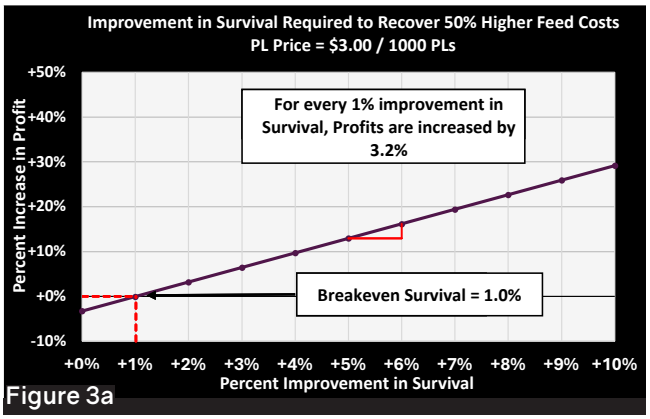
Breakeven survival

While most hatchery managers agree that higher-quality feeds can improve survival, switching to a more expensive diet involves risk. If survival does not increase enough to offset the higher feed cost, the operation can lose money. This concern is especially important when PL prices are low, because a larger improvement in survival may be needed to cover the added cost. The key question then becomes: How much must survival improve to justify the use of a higher-priced feed?

A simple example helps illustrate the concept. Consider a hatchery using a lower-cost feed with an average cost of USD20/kg and is considering switching to a higher-quality feed averaging USD30/kg. At a PL price of USD3.00/1,000 PLs, survival would need to improve by only about 1.0% to cover the higher feed cost (Figure 3a). Here, each 1% improvement in survival increases profit by roughly 3.2%.

However, if PL price falls to USD2.00/1,000 PLs, the breakeven improvement rises slightly to about 1.6% (Figure 3b), with profits increasing about 6.0% per 1% improvement in survival. Due to the high sensitivity of profits to changes in survival, even substantial differences in feed prices can be overcome with modest and realistic survival gains.

"The best strategy for improving profitability is to invest in feeds that maximise survival, especially when PL prices are low and margins are tight, as this is when profits are most sensitive to survival."



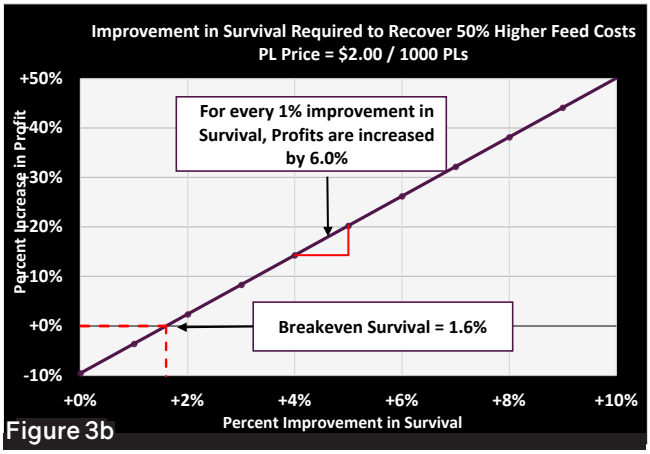


Figure 3. Percent change in profit with improved survival when switching from a baseline USD20/kg feed with 50% survival to PL12 to a USD30/kg feed. At a PL price of USD3.00/1,000 PLs (3a), profit increases 3.2% per 1% improvement in survival, and only 1.0% improvement is needed to cover the higher feed cost. At USD2.00/1,000 PLs (3b), profit increases 6.0% per 1% improvement in survival, and only 1.6% is required to cover the added cost.

Conclusion

The greatest economic gains come from improving survival because each additional PL produced directly increases revenue. Higher survival also spreads fixed costs over more animals, raising profit per unit. In contrast, lowering feed costs only reduces a small portion of total production cost, so even large reductions in feed price produce relatively small gains. As a result, only modest improvements in survival are needed to offset even large increases in feed cost.

High-quality feeds help achieve these gains by supporting healthy, fast-growing larvae with better stress and disease resistance, leading to higher survival throughout production. For this reason, the best strategy for improving profitability is to invest in feeds that maximise survival. This is especially important when PL prices are low and margins are tight, because this is when profits are most sensitive to survival.

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Future-proofing shrimp aquaculture with SPF broodstock

How genetic innovations in SPF shrimp breeding are shaping a more resilient, efficient, and socially responsible shrimp industry

By Jim Wyban

Shrimp aquaculture has been transformed by specific pathogen-free (SPF) *Penaeus vannamei*, which has helped boost global production sixfold since the late 1990s through robust biosecurity and selective breeding. SPF technology has delivered higher survival rates, faster growth, improved feed efficiency, and fewer disease outbreaks.

Ready to spawn female SPF Penaeus vannamei broodstock at the NBC in Kona.

Hawaii, the birthplace of SPF technology, has supplied over 7 million broodstock around the world since 1999. Today, new technologies, such as AI-driven genomics, climate-smart breeding, and gene editing, are paving the way for a new generation of shrimp that are even more resilient, productive, and sustainable.

In a review article for the new journal *Critical Insights in Aquaculture*, I examined the evolution, market dynamics, and ongoing challenges within the SPF shrimp broodstock industry, including genetic bottlenecks, price pressures, and piracy. The review outlines how integrating advanced genetics with strong biosecurity and adaptive business models can help create a future-proof shrimp industry—one capable of meeting global food demand while withstanding disease, climate stress, and market volatility. Below is a summary from this review. The full text is available at: (https://doi.org/10.1080/29932181.2025.2508544)

Turning point

The introduction of SPF *P. vannamei* to Asia in the late 1990s marked a major turning point in shrimp aquaculture, replacing vulnerable wild-type stocks with biosecure, domesticated lines. As a result, global shrimp output increased to over 5.9 million tonnes in 2024 from 800,000 tonnes in 1998.

A cornerstone of the shrimp farming industry, demand for SPF shrimp can be attributed to the need for greater productivity and profitability with resilient, high-quality disease-free stock that prevents major disease outbreaks, such as early mortality syndrome (EMS) and white spot syndrome virus (WSSV), which have historically devastated shrimp farms globally.

Evolution of SPF shrimp broodstock

SPF technology emerged in Hawaii in the early 1990s through a USDA-funded program aimed at solving the disease crisis in U.S. shrimp farms. The first SPF shrimp were produced in Kona in 1991 and quickly demonstrated superior performance in commercial trials. By 1992, the U.S. industry was fully stocked with SPF post larvae, doubling production compared to previous years and setting a precedent for global adoption.

The establishment of High Health Aquaculture brought SPF broodstock to Asia, beginning with Taiwan in 1998, which saw equally impressive results as in the U.S., and triggered widespread adoption in Asia. Hawaii became the primary global hub for SPF broodstock production, exporting to over 26 countries and earning its title as "shrimp breeding capital of the world."

Breeding efforts in SPF shrimp have focused on growth rate, disease resistance, and reproductive performance. Studies have shown that selective breeding programs incorporating SPF principles have significantly reduced susceptibility to WSSV and EMS.

We can expect that emerging advances in genomic selection and marker-assisted breeding will further optimize growth traits and immune response genes and contribute to supporting the long-term sustainability of SPF shrimp. However, challenges remain in balancing genetic diversity with production efficiency, requiring continued innovation in shrimp broodstock selection and biosecurity management.

Industry structure and market trends

SPF broodstock production is now a global enterprise, with major U.S. hubs in Hawaii, Florida, and Texas and significant operations in Thailand, Mexico, and Madagascar. Leading companies include Shrimp Improvement Systems, Kona Bay/Hendrix Genetics, CP Group, SyAqua, and Blue Genetics.

Market pressures, oversupply, and price declines have driven mergers and acquisitions, as seen with the acquisition of SyAqua by Ocean 14 Capital and the merger of Blue Genetics and SPD (Sea Products Development). While consolidation can streamline operations and improve genetics, it also has risks, such as reducing genetic diversity and limiting competition.

Asia dominates SPF broodstock demand, led by China, India, Vietnam, and Indonesia. China remains Asia's largest

Company	NBC location	BMC locations	Species	Broodstock
Shrimp Improvement Systems (SIS)	Florida	Hawaii	*P. vannamei*	300,000
Kona Bay/Hendrix Genetics	Hawaii	Indonesia, India, Thailand, Ecuador	*P. vannamei*	250,000
CP Group	Thailand	Thailand, Florida	*P. vannamei* *P. monodon*	150,000 30,000
SyAqua	Thailand	Florida	*P. vannamei*	140,000
Blue Genetics/SPD	Mexico	Texas, India	*P. vannamei*	140,000
American Penaeid Inc (API)	Florida		*P. vannamei*	120,000
Moana Technologies	Hawaii	Vietnam, India	*P. monodon*	90,000
Unima	Madagascar	India	*P. monodon*	15,000

Table 1. Major SPF broodstock companies ranked by 2024 total broodstock exports (Source: Shrimp Insights 2025). The data presented in this review were collected from multiple sources, including public industry reports, direct interviews with SPF shrimp producers, and peer-reviewed scientific literature. Official production statistics were sourced from government aquaculture agencies (e.g., FAO and NOAA) and private industry reports from leading shrimp breeding companies. https://www.shrimpinsights.com/blog/2025-update-spf-l-vannamei-broodstock-market

Author in a broodstock multiplication center (BMC) he designed in China.

shrimp farming industry and the largest market for SPF broodstock, with an estimated annual demand of 1.5 million broodstock. While approximately half of this demand is met by domestically produced second-generation broodstock, the remaining half is supplied by both locally produced and imported first-generation broodstock. In contrast, Ecuador uses an alternative "All Pathogen Exposed" strategy rather than importing SPF broodstock.

Broodstock multiplication centers (BMCs) are reshaping supply chains by enabling local broodstock production from imported parent post larvae (PPL). Both Hendrix Genetics and Blue Genetics have established BMCs in India. Kona Bay's BMC in Indonesia has grown its market share to around 67%, which is proving to be a successful investment for the company.

Current challenges

Reliance on multinational breeders increases the risk of genetic diversity and vulnerability to new pathogens. Sustaining genetic health requires multi-source procurement, regular diversity assessments, and the occasional wild genetic introductions.

Low post-COVID shrimp prices have reduced stocking and encouraged use of uncertified "pirate" broodstock, undermining biosecurity and performance.

The unregulated reproduction of SPF-derived shrimp without proper biosecurity erodes trust, increases the risk of outbreaks and destabilizes the industry.

Emerging technologies for a future-proof industry

BMCs reduce shipping costs, mitigate logistics disruptions, and improve broodstock quality through local production. Exports of PPL (parent PL) from Hawaii breeding companies (*P. vannamei* and *P. monodon*) are reported by the Hawaii Department of Agriculture and have ranged from 800,000 to 1,100,000 over the last 4 years.

Broodstock rearing raceways in a broodstock multiplication center (BMC) in Thailand, designed by the author.

Non-ablation methods improve shrimp health and marketability, though they require selective breeding for natural reproduction. The industry is gradually shifting towards non-ablation techniques, driven by ethical concerns and market pressures such as certification of non-ablation practices. While non-ablation methods may pose short-term challenges, such as higher costs and lower initial productivity, they may offer long-term benefits, including improved broodstock sustainability and access to premium markets for ethically produced shrimp.

Genomic selection (GS) accelerates genetic gain by using genome-wide markers (SNPs) to predict breeding value, enabling earlier selection for growth, disease resistance, and environmental tolerance. It offers the potential to increase disease resistance and growth, while improving overall productivity traits. GS also allows for the identification of animals with high genetic potential early in life and reduces the time between generations, accelerating genetic improvement.

CRISPR-based gene editing offers targeted disease resistance without foreign DNA insertion, reducing reliance on vaccines and chemicals while enhancing sustainability. Disease-resistant plants and animals reduce the need for chemical treatments, such as pesticides, antibiotics, and fungicides. Gene-edited organisms contribute to more sustainable practices by improving yield and reducing disease losses.

SPF *P. monodon* broodstock are now commercially available, and their use has significantly improved its farming. Recent success in India using SPF *P. monodon* is encouraging farmers to shift back to this species in some areas.

Biosecure SPF feeds eliminate a major pathogen risk in broodstock diets while maintaining reproductive performance. The development of SPF worms is a critical component of the diet for SPF shrimp broodstock, providing high-quality, pathogen-free nutrition to enhance reproductive performance and risk of introducing disease.

Outlook: Two possible futures

The industry faces a choice:

- Traditional model – fragmented, high-risk, reactive farming with limited technology and unstable profits.
- Modern integrated model – vertically integrated, technology-driven, sustainable, and market-oriented operations with strong genetic programs.

A future-proof shrimp industry will require coordinated investment in genetics, biosecurity, and marketing to double global per capita shrimp consumption, raise prices, and fuel sustainable production growth.

Conclusion

SPF shrimp broodstock have reshaped aquaculture, but sustaining progress requires embracing emerging genetics, preserving diversity, and adapting to economic realities. Hawaii's leadership, combined with AI-powered genomics, climate-smart breeding, and ethical production practices, positions the industry to thrive despite biological and market uncertainties. Future-proofing will depend on bold innovation, global collaboration, and strategic marketing to ensure shrimp farming remains profitable, sustainable, and resilient for decades to come.

Reference

Wyban, J. (2025). Current trends, challenges, and genetic innovations in the SPF shrimp broodstock industry. Critical Insights in Aquaculture, 1(1). https://doi.org/10.1080/29932181.2025.2508544

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Integrated and sustainable farming in Malaysia

At YHL Desaru, entrepreneurship focuses on using biotechnology and innovations to build a sustainable shrimp farming business

By Zuridah Merican

Among the more established and traditional shrimp farms in Malaysia, seven-year-old YHL Aquatic Sdn Bhd in Desaru, Johor stands above the rest. Covering a land area of 269.3 acres (107.7ha), YHL is now one of the largest shrimp farms in Johor state. Since 2023, it started hatchery operations in Mersing, producing post larvae using broodstock from the NBC (nucleus breeding centre), at YHLF Biotech (Thailand) in Phang-Nga, a subsidiary. YHL also operates Malaysia's first BMC (broodstock multiplication centre) to reduce reliance on imports and to strengthen Malaysia's shrimp aquaculture industry.

In 2025, the company received the "Asia Aquaculture Excellence Award - Excellence in Marine Shrimp Seedlings", presented by the Malaysia Aquaculture Development Association (MADA), during its 25th Anniversary Celebration Dinner.

This prestigious award recognises YHL's outstanding achievements in shrimp post larvae production and further validates the company's commitment to IMTA (Integrated Multitrophic Aquaculture) practices for sustainable shrimp farming.

An earlier achievement is the JCI (Junior Chamber International) Malaysia Sustainable Development Award SDG 14: Life Below Water" in 2023 which reaffirmed the company's leadership and innovation in sustainable aquaculture development.

From oysters to vannamei shrimp

YHL's Founder and Managing Director, Low Yuan Heng entered shrimp farming by chance. Low, a graduate in food science from Universiti Putra Malaysia, already had an established food additive business when he was encouraged to start oyster farming back in 2010.

"We have *Crassostrea iredalei* and *C. belcheri*. I saw an aquaculture opportunity as there is no specific breeding season and spats are available all year round in our coastal waters," said Low.

"However, in order for the oysters to reach market readiness, an eight-month culture period was required, with anticipated cash flow projected only after three years. Therefore, I considered integrating another aquaculture species and explored shrimp farming as a complementary venture alongside the oyster."

The Malaysian Bioeconomy Development Corporation (Bioeconomy Corporation), operating under the Ministry of Science, Technology and Innovation (MOSTI), has granted BioNexus status and recognition as a Bio-based Accelerator (BBA) company to YHL's Tropical Oyster subsidiary and YHL Aquatics, respectively. It has continuously supported YHL in their transition and growth.

Current view of YHL Desaru, with 67 grow-out ponds and 35 nursery ponds, covering 78 acres (31.5ha). As the team adds more ponds, pond sizes change as well as operational protocols. Source: YHL Aquatics Sdn Bhd.

Low started his shrimp farming business on 10 acres (4ha) of land. Today, while sentimental towards his original oyster venture – selling oysters at MYR2 each in 2012- he has steadily expanded shrimp farming in phases, making structural and operational improvements, after visiting several farms in Vietnam, Thailand and China.

The main driver: Sustainable aquaculture

Prior to starting his venture, Low researched sustainable farming policies, referring to the work by Dr Sarah J. Foster, a marine conservation scientist who provided science-based guidelines for sustainable farming.

"Fortunately, this area was previously used for silica sand production, which means I do not need to address concerns on mangrove destruction for shrimp farming." The Johor state government has designated the area covering 9,000 acres (3,642ha) as "Bio Desaru – The Organic Food Valley" as a major hub for organic farming, bio-agriculture, aquaculture, and eco-tourism.

Low applies his tagline, "Saving the oceans starts with me" when designing the infrastructure and developing operations for high density shrimp farming. All wastewater is channelled into sludge ponds and overflows into six sedimentation ponds continuously. "We stock milkfish and tilapia to clean up the water and add probiotics.

"As we grow larger, we believe that it is important to have stability in production, rather than seek to increase volumes with higher stocking density," says Low Yuan Heng.

Ponds are aerated. Lastly, we have oysters, bivalves and aquatic plants to filter out organic particles. Water is used for the culture of copepods, which are the live feed for the fish hatchery." This is the IMTA project.

"This idea of this IMTA is to solve aquaculture's pollution issue, reduce nutrient pollution, eutrophication and recycling waste into usable biomass. This is a first in Malaysia. We use nine acres (3.64ha) dedicated to IMTA which is still not fully complete," said Low.

Expansion and innovation

Construction of shrimp ponds began in 2017, alongside the existing oyster hatchery facility. The seawater intake is 6m deep and 800m out at sea, which YHL acquired when it bought over the land previously set up for a fish hatchery.

In the first phase of 10 acres (4ha), pond sizes were 0.1ha; in the second and third phases, pond sizes increased to 0.25ha, and in phase 4, currently ongoing, ponds are 0.4ha with 1.5-1.8m depths. Today, YHL's farm in Desaru has a total of 67 grow-out ponds with central outlets. It was necessary to line ponds and dykes with 1mm high density polyethylene (HDPE) as the area has sandy soil.

Each phase uses its own filtration system and reservoir. In phase one, stocking density is 200 PL/m^2 but decreases to 150 PL/m^2 for ponds in the latter phases. Low clarified, "As we grow, we believe that it is important to have stability in production, rather than seek to increase volumes with higher stocking density."

"We farm vannamei shrimp, producing 945 tonnes in 2024 with a target of 1,500 tonnes for 2025. Each cycle includes five partial harvests to ensure a daily supply of 4-5 tonnes for Kuala Lumpur, Johor Baru and Singapore. Buyers appreciate the reliable daily shipments. In October, farmgate prices were MYR19.50/kg (USD 4.71) for size 70/kg and MYR29.50/kg (USD 7.13) for size 30/kg. The lowest price for size 70/kg in 2025 was MYR15/kg.

"Buyers seek shrimp of size 90-30/kg. Size 25/kg is the largest size that they will take. I am proud of the colour of our shrimp, rated 24 on the chart when cooked, reflecting our genetics. Our cost of production is around MYR19.50 (USD4.71) and average selling price is MYR24.50 (USD5.92)."

The integrated multitrophic aquaculture (IMTA) project covers 9 acres (3.64ha).

Innovating with a nursery phase

"In 2020, after completion of the second phase, we faced a serious *Enterocytozoon hepatopenaei* (EHP) outbreak. We were lucky as we already included a nursery stage in our farming protocol. It was a 1:1 model, one nursery pond of 150m^3 to a grow-out pond of 0.1ha. We stocked 1,000 PL/m^2 in the nursery pond. At such a high density, I could already catch an EHP infection at 1g at the nursery stage. If I were to stock directly into grow-out ponds, the signs of an outbreak can only be seen after 40 days."

Low added, "It was at this time that I looked around for alternative genetics. In Phang-Nga, researchers at Thailand's National Centre Genetic Engineering and Biotechnology (BIOTEC) were already using molecular genetics in shrimp to manipulate shrimp traits for aquaculture. Together we founded the subsidiary YHLF Biotech (Thailand) and established a NBC."

The farming cycle starts with PL10 from his own hatchery in Mersing. The nursery cycle is over 21-28 days, and grow-out duration is 75-84 days. Low said that survival rates at harvest hover around 80%. "We are managing well because of our operational protocols. Our average daily growth is 0.4g-0.5g, which I attribute to the YHL-PHI TIK *Litopenaeus vannamei* post larvae from broodstock with rapid growth, robustness and disease tolerance to EHP developed at YHLF Biotech over 49 generations since 2018."

Low explained, "Juveniles are transferred to grow-out ponds using pipes and tanks, with the entire process taking about four hours. We experience only about 1-2% loss during transfer. Our nursery ponds are distributed throughout the pond area. To minimise stress before transfers and later before harvesting, we include feed supplements such as extra minerals and astaxanthin."

Among several other innovations that YHL has been testing out is the combination of pineapple extracts and *Bacillus* probiotics to mitigate white faeces syndrome (WFS). An idea from observations on shrimp farming in China is the in - house production of PSB (photosynthetic bacteria) and EM (effective microorganism) probiotics for improving soil/water quality and enhancing aquatic health by reducing toxins and pathogens. YHL has an innovative way to maintain aeration at 5ppm with air diffusers and paddlewheels.

The farm has 60 staff to operate ponds comprising of the usual hierarchy in pond management, where the farm manager oversees pond supervisors. "We recruit our technicians from Sabah and Sarawak, namely graduates from Polytechnic Sandakan in Sabah. We use auto feeders

Above, all ponds have 1 mm HDPE liners, and the team has an innovative way to increase and maintain aeration at 5ppm (left).

Clockwise, from top left, Low is sentimental towards his original oyster venture producing cupped oyster Crassostrea iredalei; with Jafni bin Muhammad, Malaysian Bioeconomy Development Corporation Sdn Bhd (right) who organised the visit, and the cooked colour of YHL's vannamei shrimp is attributed to the genetics at YHLF Biotech (Thailand).

but, I noticed that feed conversion ratio (FCR) can range from 1.2 to 1.3 but can rise to 1.7-1.8 depending on the technician."

Looking ahead

Low says that he has set an annual target of 4,500 tonnes for this farm. There are plans to start a processing plant to market a more extensive range of products. However, although the farm will continue to expand vannamei shrimp farming, he indicated, "YHLF is working on genetics for the black tiger, and then I will be ready to start farming this shrimp, to support the processing plant."

YHL will continue to be an active component of the strategy to position Johor as a regional aquaculture hub, combining biotechnology, sustainability, and ecotourism. Coming soon is an ecotourism project at the farm. "Desaru is a well-known tourist destination, and I want to showcase to all, a model prioritising sustainable shrimp farming and aquaculture ."

Unlocking the power of smart feeding of vannamei shrimp

A strategic leap forward in precision aquaculture with wireless connectivity in shrimp feeding and acoustic monitoring to help farmers boost feed efficiency, and optimise pond performance

By Keone Dodd

The Smart Hydrophone marks a major leap in precision aquaculture. Built on more than 15 years of research into shrimp feeding patterns and acoustic monitoring, it overcomes the limits of cabled systems and adds intelligent self-diagnostics for superior reliability. By aligning technology with biology, it helps farmers boost feed efficiency, cut waste, and optimise pond performance.

At AQ1, innovation begins with listening. Over the years, we have worked closely with shrimp farmers, gathering feedback and conducting extensive field research to better understand shrimp feeding behaviour and the operational challenges faced in real-world pond environments.

Now, that commitment to listening has inspired our next leap forward: AQ1's next-generation smart feeding ecosystem begins with the Smart Hydrophone—a breakthrough device for shrimp farmers, built to integrate with future AQ1 technologies for unmatched performance.

Designed with farmers in mind

Traditional hydrophones have been limited by 90m cables, restricting placement and often requiring compromises in pond layout. The Smart Hydrophone changes that. With a wireless connectivity range of up to 250m, farmers can now position hydrophones exactly where they are most effective, whether in large extensive ponds (up to 10ha) or complex intensive systems (Figure 1). This flexibility not only improves feeding accuracy but also reduces infrastructure complexity, minimises interference, and lowers maintenance requirements by removing long data cables from the equation.

The Smart Hydrophone features a novel built-in self-diagnostic system. This proactive monitoring helps farmers detect issues early, reducing downtime and ensuring consistent feeding performance.

Our decision to move away from cabled hydrophones is grounded in years of field data and direct customer feedback. Research has shown that the effective listening range of a hydrophone varies significantly depending on pond conditions. To optimise detection of shrimp feeding activity, we recommend limiting each hydrophone to a maximum of three feeders per zone, a configuration that improves acoustic signal clarity and feeding response accuracy.

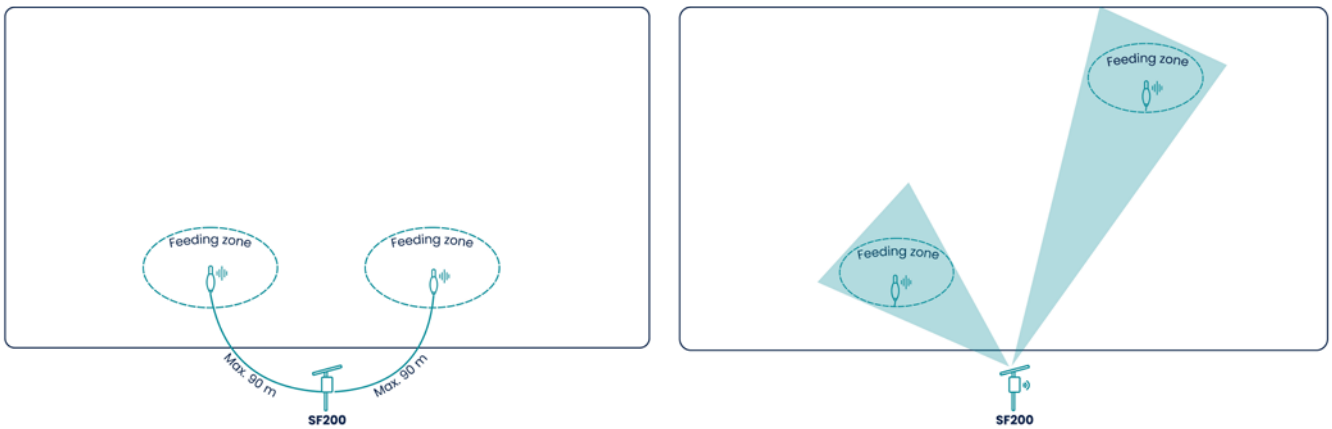


Figure 1. A side-by-side schematic showing an old setup with two wired hydrophones with 90m maximum cable length to sonic feeding controller - SF200 (left) versus the new setup with two Smart Hydrophone with wireless connectivity of 250m range (right).

Optimising feeding with multiple zones

Feeding efficiency is a cornerstone of successful shrimp farming, and AQ1's research has shown that multiple feeding zones with fewer feeders per zone offer a more effective and responsive approach to feed delivery. This configuration allows the sonic algorithm to accurately detect and respond to shrimp feeding behaviour, resulting in better feed utilisation and more uniform growth.

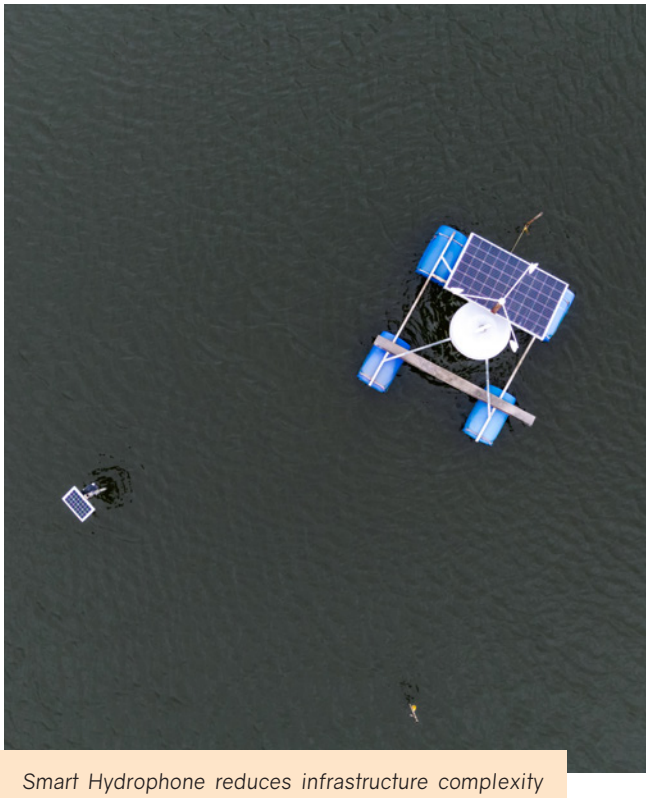
Shrimp feeding sounds can be masked by background noise or diluted across large areas. By limiting the number of feeders per hydrophone to a maximum of three, farmers can ensure that the hydrophone receives a clear and concentrated acoustic signal. This improves the accuracy of the system's response and helps avoid overfeeding or underfeeding in any zone.

The Smart Hydrophone's wireless design also brings major benefits to intensive pond systems, where space is limited and infrastructure is dense. In these environments, the presence of numerous electrical cables can cause interference, which may affect the sensitivity and accuracy of sonic feeding detection. By eliminating the need for long data cables, the SM1 reduces this interference risk and simplifies installation.

How does shrimp benefit from multiple feeding zones?

At AQ1, we have spent years observing shrimp feeding behaviour across ponds and discovered a key insight: feeding activity is not uniform. Shrimp tend to feed more intensely at specific times of day and show a clear preference for certain areas within the pond.

To help farmers respond to this variability, we have expanded our feeding zone capability from two zones (wired connection to SF200, limited to 90m) to four zones (wireless connection to SF200, up to 250m).This upgrade reflects our behavioural insights and offers a seamless pathway for existing AQ1 controllers to scale; enabling more precise, responsive feeding aligned with shrimp behaviour.



Smart Hydrophone reduces infrastructure complexity with simple set up.

Shrimp thrive when food is accessible, delivered where and when it is needed, and aligned with their natural rhythms. Implementing multiple feeding zones, especially when paired with AQ1's sonic feeding technology, offers a range of biological and operational benefits:

- Reduced competition and stress: Distributing feed across zones reduces crowding and aggressive behavior, improving shrimp welfare.
- More uniform growth: Equal access to feed minimises size variation, leading to better harvest consistency and pricing.
- Optimum feed conversion ratios (FCR): Feed is delivered only when shrimp are actively feeding, reducing waste and improving efficiency.
- Enhanced water quality: Even feed distribution and real-time control help prevent overfeeding and maintain better pond conditions.
- Adaptability to pond conditions: Multiple zones allow feeding strategies to be tailored to pond shape, depth, and water flow.

"At AQ1, we have spent years observing shrimp feeding behaviour across ponds and discovered a key insight: feeding activity is not uniform."

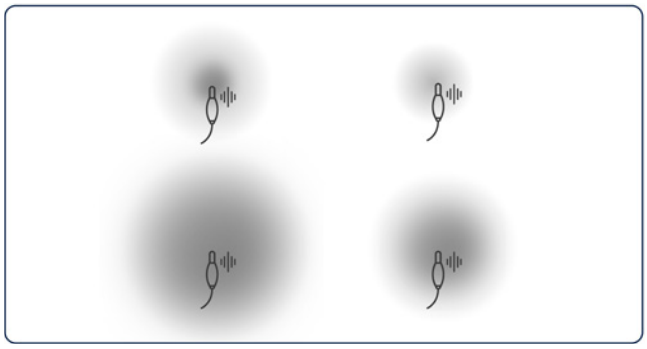


Figure 2. A pond map showing shrimp distribution and feeding activity across multiple zones

How does the smart hydrophone help farmers expand and manage feeding zones?

The Smart Hydrophone is designed to make multi-zone feeding practical and scalable (Figure 3). Here is how it empowers farmers:

- Wireless flexibility: Hydrophones can be placed exactly where needed, up to 250m from the controller, without cable constraints.
- Zone expansion: Each SF200 controller can now manage four Smart Hydrophones, doubling the number of feeding zones from two to four.
- Improved accuracy: With fewer feeders per hydrophone and better placement, the system can more precisely detect feeding activity.
- Simplified infrastructure: Especially in intensive systems, removing cables reduces installation complexity and interference.
- Ready for the future: The Smart Hydrophone is designed to integrate with upcoming AQ1 innovations for even greater performance.

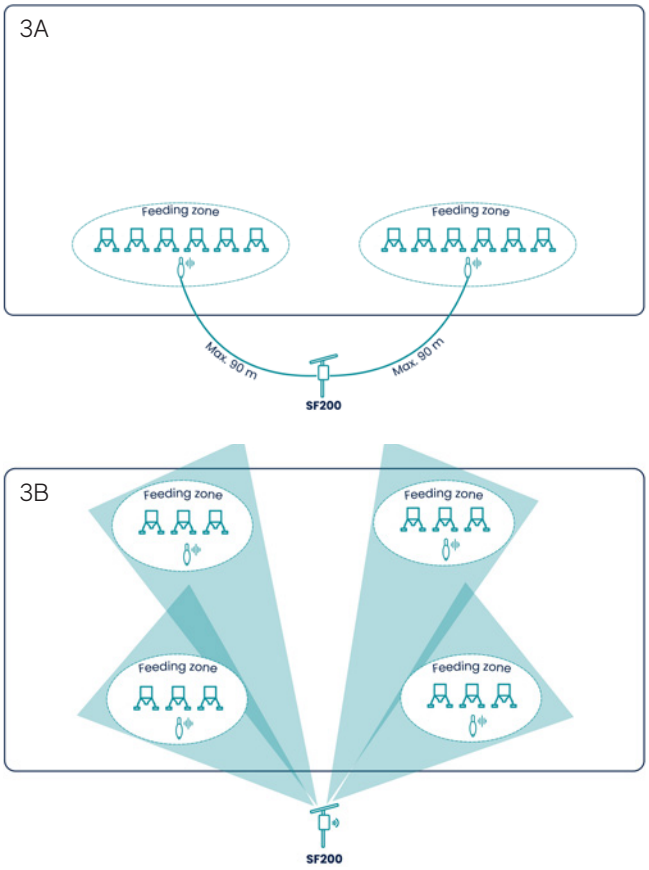


Figure 3. A comparison of systems. 3A is a traditional cabled hydrophone set up in a pond. 3B is a scalable configuration with one SF200 controller managing four Smart Hydrophones for practical, multi-point feeding control across a large pond.

The Smart Hydrophone is more than just a new product; it is strategic leap forward in precision aquaculture. By enabling flexible, cable-free deployment and supporting more feeding zones per controller, it helps farmers improve efficiency, shrimp health, and operational scalability.

Therefore, whether managing a 10ha extensive pond or a high-density intensive system, the Smart Hydrophone offers the tools to optimise feeding. Backed by AQ1's deep commitment to research and innovation, the Smart Hydrophone is setting a new standard for smart, sustainable shrimp farming.

Keone Dodd, is Technical Director at AQ1 System, Australia.
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Hard Talk: A real debate with a simulated value chain

At TARS 2025 on Shrimp Aquaculture in Chiang Mai, Thailand, industry leaders from Asia and Latin America dissected the shrimp sector, from genetics and production systems to governance and welfare. How does Asia's shrimp value chain compare to that of Latin America's far more consolidated model? It was an analysis of the value chain and overcoming shrimp aquaculture dysfunction in Asia

From left, Ronnie Tan, US Grains and Bioproducts Council; Ravi Kumar Yellanki, Vaisakhi Bio-Marine, India; Preecha Ekatumasuit, TRF Feed Mill, Thailand; Henrik Aarestrup, BioMar Group, Denmark; William R. Kramer, HP Aquafarm Inc, Philippines; and Christopher Tan, Mida Trade Ventures, Singapore.

Ronnie Tan, Aquaculture Consultant at the US Grains and Bioproducts Council and moderator of this Hard Talk, arranged a live simulation of the shrimp value chain with a five-member panel. They were **Ravi Kumar Yellanki**, Managing Director, Vaisakhi Bio-Marine Pvt Ltd, India, representing genetics and hatcheries; **William R. Kramer**, Managing Consultant, CCM Agri Aqua Ventures Corp, HP Aquafarm Inc, Philippines, representing the farming segment; feed millers **Dr Preecha Ekatumasuit**, CEO, TRF Feed Mill Co Ltd, Thailand and **Henrik Aarestrup**, Vice President, LATAM, Shrimp & Hatchery, BioMar Group, Denmark; and **Christopher Tan**, Director, Mida Trade Ventures Pte Ltd, Singapore, representing the processor–buyer segment.

"Genetics forms the foundation, shaping performance from hatchery to processing. However, hatchery practices make or break that potential along the value chain," said Ravi Kumar Yellanki.

"We developed this as some people argue that the value chain in Asia is weak because of our fragmented nature," clarified Ronnie on why he took this line of thought.

What makes good quality post larvae?

In the debate between nurture versus nature, which matters more to produce high-quality post larvae: genetics or hatchery practices? Ravi Kumar did not pick a side. "Both," he said. Genetics "forms the foundation," shaping performance from hatchery to processing. When all is equal, hatchery practices make or break that potential along the value chain.

"Disease-free broodstock, feeding post larvae well, and suppressing *Vibrio* loads are critical. If hatcheries fail to control *Vibrio*, they simply pass the inoculum downstream."

Operational discipline matters. Large hatcheries must stock, sell post larvae, and complete cycles; a modular approach or periodic shutdowns reset *Vibrio* contamination. The goal is maintaining disease-free status, controlling bacteria, and ensuring robust post larvae.

Ronnie noted that farmers often blame genetics when they are disappointed with post larvae quality. Ravi Kumar pushed back, arguing that while genetic companies

can deliver disease-free broodstock and desired traits, "beyond that, there is no role for genetic companies," as hatchery practices determine outcomes.

From the farmer's perspective, William framed it as "50–50" once husbandry takes over in the open and highly variable farm environment. On the compensation gimmicks by hatcheries (providing as much as 100% extra post larvae), William objects to offers of bonus post larvae to compensate for weak ones, preferring instead to plan around a realistic 15–20% survival allowance. "What matters to me is headcount in the pond, not freebies."

Push for shrimp welfare with non-ablation practices

The practice of no eyestalk ablation in shrimp farming is increasingly becoming a certification requirement due to evolving animal welfare standards. Christopher gave his take from a buyer's perspective. "We have a clear line here. The high-end European retailers often impose non-eyestalk ablation production on welfare grounds. However, 95% of the commodity market is not so easily persuaded on non-ablation." Are buyers willing to pay more? "No," added Christopher. "The cost must land somewhere else in the value chain."

Technically, Ravi Kumar said that there are some advantages to non-ablation of vannamei shrimp broodstock. "We can run without ablation for lines with strong reproductive efficiency. But not with the monodon shrimp, at least for now." He added that even within vannamei shrimp, low-reproduction lines still require ablation to achieve mating frequency and nauplii volumes.

"When non-ablation works, output equalises by the second month; mating percentages catch up, and broodstock can remain productive longer, up to 5 months from the 3.5 months with ablation practices. Hatchery survival rates seem better with post larvae from non-ablated broodstock." He added that although field evidence suggests that post larvae from non-ablated broodstock are robust, it would be necessary to compare data on the field performance of post larvae from the same batch of broodstock, half of them ablated and the other half non-ablated.

On costs, Ravi Kumar said, "There is no extra cost for non-ablated vannamei, provided the broodstock is from lines with good reproductive efficiency. For weaker lines, costs rise, which forces hatcheries to revert to ablation."

Which to stock: PL10-12 or PL35 juveniles?

Ronnie sought feedback comparing Asia and Ecuador. Is there a cost advantage in using PL12 versus PL35 juveniles? As a farmer in the Philippines, William said, Personally given the conditions at our farm, we prefer stocking PL10-12 in our nursery or mother ponds at a maximum of 900PL/m^2). We start transferring juveniles starting at 23 to 30 days of culture to respective grow-out ponds at densities of 130 to 150/m^2. Our ponds average 1,300m^2."

Henrik described the Ecuadorian approach. There is an entirely different practice, linked with integration. Despite stereotypes, PL35 is not a hatchery product; it is farm reared. "In Ecuador, PL35 is part of the farm, not sold by hatcheries. Most transactions are still for PL10–PL12, but consolidation is pulling hatcheries into integrated groups. Big farmers are owning hatcheries and genetics. Therefore, published "market prices" are blurred within intra-group transfers."

The panel discussed whether nurseries are part of the farm or standalone. Preecha explained the changes in Thailand. "Today, small farms increasingly coordinate with hatcheries to produce larger post larvae (PL17–PL18). Farms with more 'modern operations' ask for PL35–PL40 or so-called "jumbo" post larvae around 0.5g. Standalone nurseries flourished five years ago but have struggled. They have seen lower survival rates as post larvae sizes increase, while feed needs climbed and transport costs increased."

In Thailand, size, and distance complicate matters. A truck transporting 300,000 small post larvae can take only 30,000-50,000 jumbo post larvae. At the farm, stocking is usually at 300,000-400,000PL, which needs 10 trips for the truck. "Therefore, for many Thai farmers, PL12 remains the norm," said Preecha.

Integration and the salmon lesson

Henrik spoke on Ecuador's semi-integration model. He described this as more of a "joint venture," where feed millers have agreements with large producers. "Similar to that in the salmon industry, they will split feed contracts into major, medium, and minority suppliers in order to have negotiating leverage and not depend on just one large feed miller."

He cautioned that full vertical integration has its downsides. "You can only negotiate with yourself; you

"Competition among feed mills worldwide has improved feed quality. While feed is important, results depend on three factors: post larvae quality, feed quality, and farm management," said Preecha Ekatumasuit.

"In Ecuador, farms are buying processing plants to get full control of scale for year-round retail supply. This has boosted traceability." said Henrik Aarestrup.

must finance raw materials on top of production and absorb operational risks. The trend reflects the salmon industry, where some integrated groups are even putting feed divisions up for sale, such as Mowi. I would say that the Ecuadorian model is satisfactory."

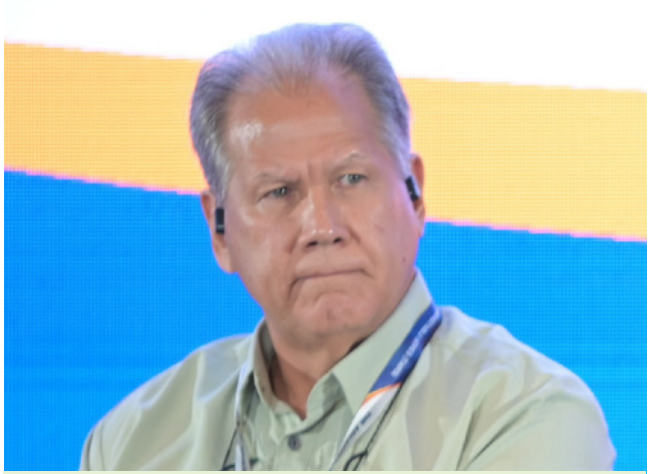
Thailand is different, said Preecha. "TRF is integrated into the shrimp processing system. The whole ecosystem (farming, feed production, and processing) acts as a "society" or "community." The processor dictates their buying needs (size 50, 30/kg, etc.). This information is passed on to the farmers. We, as feed millers, liaise with farm associations and processors so that farmers plan harvests to meet the processors' order books."

Henrik added that Ecuador has a forward or downstream integration. "Farms are buying processing plants to get full control of scale for year-round retail supply. This has boosted traceability. With this advantage in hand, few big farmers want to integrate upstream into feed production."

When the blame is on feeds

"Feed companies are usually blamed for poor shrimp growth performance," Ronnie prompted. William responded, "First, 70% of the problem is in the farm. Poor management leads to overfeeding and low survival rates. Farms with best practices can deliver solid returns (ROI) even by using average quality feed."

Henrik acknowledged that finger-pointing exists but backed a systematic approach at the farm. "Good farm management can even mask a weaker feed. Major customers consistently evaluate various feed suppliers and monitor performance benchmarks. This happens in the shrimp and salmon world."



"Farms with best practices can deliver solid returns (ROI) even by using average quality feed," said William Kramer.

Preecha explained that when crops fail, farmers often blame poor post larvae, feed, disease, or climate change. However, he believes that competition among feed mills worldwide has improved feed quality. While feed is important, results depend on three factors: post larvae quality, feed quality, and farm management.

The promise of acoustic feeding

Ecuador has embraced acoustic feeding. AQ1, now part of BioMar, has among the best-known systems. However, acoustic feeding draws scepticism in Asia. Has it really improved the feed conversion ratio (FCR) and sped up cycles in Ecuador?

Henrik affirmed that gains come from the device, nutrition, and the management system it enables. "Together with improved genetics, farms moved from 2–3 cycles/year to 5 or even 6 cycles/year to produce small-size shrimp. However, this system requires large capital investment and strong organisations to roll out and utilise the technology. It is feasible in consolidated Ecuador but is much harder in fragmented Asia."

Henrik said that by volume, the vast majority of Ecuador's output comes from acoustic feeding practices. By hectares, there is still room to expand.

In India, Ravi Kumar sees the uptake of smart feeders "catching up," despite high capital expenditure. Small ponds make manual feeding feasible. "Such technology saves feed by reducing FCR by ~0.2, and keeps pond bottoms cleaner, allowing for longer cycles to produce large-size shrimp. Timed dispensers are not that revolutionary, but acoustic systems really decouple from workforce reliance."

Preecha concurred with Ravi Kumar. In Asia, small ponds, high stocking density, and environmental sounds complicate the use of sensors. However, he foresees that AI-assisted sound filtering, CCTV for shrimp behaviour monitoring, and integration with aerator telemetry will help.

William echoed on the Philippines' lag. "Acoustic feeding is not considered partly because small, intensive ponds have "so much activity" inside and out." Even so, he accepts the premise that FCR improvements of 0.2-0.3 are plausible.

Henrik reminded that algorithms already filter aeration and pond noise. AQ1 has even solved a bug where a stray sound mimicked clicks of shrimp mandibles.

Christopher Tan said, "The irony is that most global markets accept subpar shrimp. So, until demand changes towards fresh high-quality shrimp, supply chains have little incentive to upgrade."

Post-harvest: Great shrimp, mediocre chains

Some Asian farmers harvest high-quality shrimp, but post-harvest chains fail to preserve them. Can buyers shorten the chain?

Christopher responded that geography is a factor. Indonesia is a large archipelago, and farms with optimal conditions are on remote islands, where it is not feasible to site a processing plant. It takes 3-4 days for the harvest to reach processors. "However, the irony is that almost 70-80% of global markets accept subpar shrimp. The US, the largest market for peeled shrimp, accepts heavily soaked shrimp. China's vast dim sum segment values convenience over pristine texture; only Michelin-level niches demand the best quality. So, until the demand changes, supply chains have little incentive to upgrade."

On the topic of soaking shrimp, Ravi Kumar stated that STPP (sodium tripolyphosphate) at 5% is commonly used for soaking shrimp. Some buyers, especially in Europe, now prefer chemical-free or alternative "salt" cures.

"Unfortunately, in most markets, even Japan, there is demand for heavily soaked shrimp. European consumers tend to avoid STPP, while allowing for 20–30% glazing. Market preferences are reflected in their willingness to make cost-related decisions," said Christopher.

Fragmentation as risk or resilience?

Over 70% of Asian shrimp production comes from small- and medium scale farms, while the same share in Ecuador comes from large groups. Is this a strength or a weakness?

Ravi Kumar noted, "In fragmented Asia, exporters often trade rather than own responsibility. Yet the advantage of smallholders is that they are resilient: when they fail, they recover fast. Big corporations, once down, struggle to pivot. His view is that Asia will be unable to integrate rapidly; therefore, collaboration across genetics, hatchery, feed, farm and processing is crucial.

Preecha added that small farms can time their production to China's "golden periods" (four times a year). They tailor output to preferred colours and sizes and operate with tightly controlled labour costs. The main constraint, however, is financing—high capex tools such as acoustic feeders remain out of reach.

For William, Asia's fragmentation benefits across more people in the value chain, but the continent's geographic and operational variability makes standardisation hard, while offering multiple pathways to compete.

Henrik referred to market served. For local live or premium niche markets, small farmers can beat giants. For mass retail with year-round contracts, low cost and traceability, large integrated groups have the edge.

Christopher injected a buyer's view that "integration must add value". "Many farmers prefer the freedom to sell to the highest bidder, especially when disease tightens raw material supply and processors, with thousands of workers, must keep lines running. Unless integration improves farm income or risk, farmers will not rush into it."

What can Ecuador learn from Asia?

This was an open discussion with participants. Henrik sees Ecuador on an intensification journey, while Asia offers a cautionary tale on carrying capacity and limitations on stress and disease. As intensity increase, feeds in Ecuador converge toward those in Asia. For Ravi Kumar, the farming systems are "as different as baseball and cricket," i.e., huge, open ponds with all pathogen-exposed (APE) broodstock in Ecuador versus smaller, biosecure farms with disease-free stocks in Asia.

Hervé Lucien-Brun, Jefo Nutrition, France, flagged a systemic risk since about 85% of Ecuadorian farming is located on one estuary (Gulf of Guayas), and there has been no study on carrying capacity of water resources.

Dragoș Mircea, Good Tôm Company (right) with Jeffrey Lee, Kembang Subur, Malaysia.

Exceeding this could lead to a big crash, as white spot disease (WSD) once did. However, Andrés Rivadulla, BioMar, Ecuador, noted some large groups are already seeking new farming areas outside the gulf, a geographic diversification borrowed from Asia's painful experience.

Pablo Montalbetti Gómez de la Torre, Vitapro – Alicorp Ecuador, believes that growth must come from intensification, not hectarage. The way is to increase density sustainably, detect early disease signals, and pace growth, despite the pressure to recoup investments.

How can Asian producers position themselves to compete with Ecuador? According to Christopher, there are paths like niche markets such as "live", "cook-from-live," certifications or efficiency. However, many niches come and go. "The biggest challenge for most Asian processors is raw-material price volatility. Owning ponds allows you to stabilise input costs, whereas buying externally leaves you at the market's mercy.

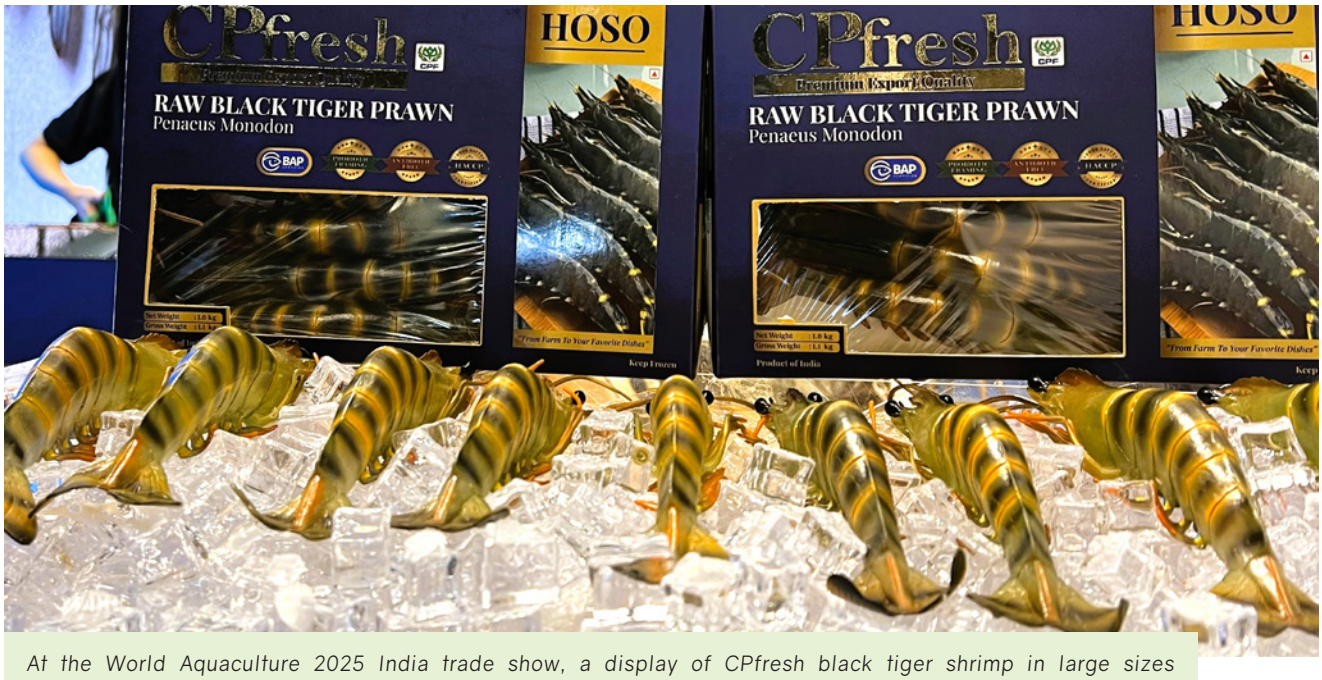
"Still, seasonality creates windows. Ecuador can be uncompetitive, as during recent outbreaks (WSD drove a price spike), early in the year (February–March) and sometimes in August–September." His recommendation is to focus on the cost curve and take advantage when these windows open.

Henrik's 30-second postscript was, "Ecuador's high labour cost leaves room for Asian processors in advanced value-added items. Competing head-on in whole and frozen is tough. In more complex consumer products, Asia's lower labour costs can shine."

A group discussion at the Interactive Roundtable Breakout Session – Part 1: The Exchange.

Asian shrimp in 2025: Steady supply and price volatility

Global shrimp production was expected to rise in 2025 with key producers such as Ecuador leading growth, while Asia showed a modest increase with variations across countries. China's output was projected to decline due to disease and regulatory restrictions. The overall outlook points to expanding supply but highlights regional disparities and challenges



At the World Aquaculture 2025 India trade show, a display of CPfresh black tiger shrimp in large sizes (13/15 count per kg), positioned for premium markets.

Global production is up in 2025

Shrimp production in 2025, driven by Asia and Latin America, is expected to increase moderately compared to 2024. At Shrimp Summit 2025, held in June in Bali, Indonesia, the Kontali team predicted that vannamei shrimp production will rise to 5.84 million tonnes, reflecting a 6% growth from 5.5 million tonnes in 2024.

In October, at the Responsible Seafood Summit 2025 in Cartagena, Colombia, RaboResearch and the Global Seafood Alliance (GSA-Rabobank) presented results of the survey on global vannamei shrimp supply. Production is expected to grow only 2–3% in 2025 to 6.1 million tonnes. The survey reported a 4% increase in global supply of the black tiger shrimp led by Vietnam, China, India and Bangladesh.

A global view on supply from top producers

Growth forecasts on Ecuador's production in 2025, included Gorjan Nikolik's (RaboResearch) at 15%. At TARS 2025, held in Chiangmai Thailand, in August, it was an almost 18% indicative growth reaching 1.75 million tonnes, by Vitapro's Pablo Montalbetti Gómez de la Torre. At the Global Shrimp Forum (GSF 2025) Sandro Coglitore, Omarsa clarified that 2024 was a flat year for Ecuador as it was in a consolidation process. Farms that had changed hands were brought back online and resumed production in 2025. A notable surge in growth in 2025, is expected to continue into 2026. Numerous farms are still undergoing ownership changes, which will impact the industry's dynamics.

Ecuador's shrimp industry continues to be the "idol" with 3-phase models: low stocking density (relative to that in most of Asia), nursery systems and almost 4 cycles/year. The news from Ecuador is that large farms buy up smaller farms, and they are increasing stocking density in low saline areas to 25-30 PL/m^2 and even as high as 40 PL/m^2.

GSA-Rabobank had forecasted a 2% growth in Asian production for the year 2025. The general view is a declining production in Southeast Asia while India's production is stagnant. Some trends suggested rising volumes for India (5.0%), lower volumes in Vietnam (-2%) and Thailand (-1%). GSA-Rabobank expected no growth in Indonesia and volumes to remain at 350,000 tonnes.

Below are some shared perspectives by local industry stakeholders regarding the situation with both vannamei and black tiger shrimp in 2025.

EHP and regulations restrict production in China

The China Statistical Yearbook reported a 2025 production of 2.37 million tonnes of vannamei shrimp. Amber Chen, Nutriera Group, China noted that 1.53 million tonnes were from saline systems and some 880,000 tonnes came from freshwater farming. Several industry players provided lower estimates. FuCi Guo, MSD Animal Health suggested around 1.7 million tonnes of shrimp production and vannamei accounted for 88%. Most domestic shrimp are consumed domestically and generally of smaller size. Farmers adjust their plans and shift to alternative

	China	India	Vietnam	Indonesia	Thailand	Philippines	Malaysia
Vannamei shrimp (tonnes)	2,370,000 (1,496,000)	989,500	470,000-600,000	230,000-245,000	232,807	29,620 (Q1-Q3)	23,000-25,200
Black tiger shrimp (tonnes)	160,000	60,500	150,000-200,000	50,000	19,589	12,725 (Q1-Q3)	16,000-16,800

Sources: Industry in China (in brackets), Vietnam, Indonesia and Malaysia. China: China Statistical Yearbook, provided by Amber Chen, Nutriera. India: Society of Aquaculture Professionals. Thailand: Coastal Aquaculture Research and Development Division, Department of Fisheries (courtesy of Vinij Tansakul). Philippines: Q1-Q3 data by Philippines Statistics Authority (PSA). Robins McIntosh, Charoen Pokphand Foods, Thailand provided estimates for Malaysia, Vietnam and the Philippines (35,000 vannamei shrimp in 2025).

Table 1: Estimates on shrimp production in 2025 from selected countries.

species, based on price signals and import surges, said Louis Zhou, HuaXin Food Group, at GSF 2025.

Industry also expect lower volumes in 2025 compared to 2024, due to stricter regulations on groundwater use and wastewater discharge enforced by both local and central authorities, slow down in local government investment in greenhouses and *Enterocytozoon hepatopenaei* (EHP) outbreaks. Guo said intensive farming in small greenhouses emerged as the main strategy for increasing production but lately small greenhouse farms in Jiangsu and Shandong have closed. Back in 2024, 450,000 of these 0.4ha greenhouses, were expected to contribute 450,000 tonnes/year.

Managing EHP well in India

A recent 2025 Society of Aquaculture Professionals (SAP) crop review reported production rising to 1.05 million tonnes, with 989,000 tonnes of vannamei and 60,500 tonnes of black tiger shrimp, according to SAP President Saji Chacko. During a SAP session at World Aquaculture 2025 India in November, higher output was anticipated in all regions, especially the west and north at 10-15%.

There have been production improvements over the past three years due to changes in stocking density. Multiple partial harvests—from shrimp size 100/kg down to 60, 40 and finally 20/kg —have boosted farmer profits, with some achieving three cycles annually. Nursery rearing also contributed to these gains.

EHP was a persistent issue for over three years, but Indian farmers reportedly managed it in 2025, through crop cycle adjustments and selecting suitable post larvae from various broodstock lines, according to Ganesh Moorthy, CP India. With multiple genetic lines now available, farmers are eager to verify the specific line of purchased post larvae (balanced, fast, or hardy).

In southern India, some farms start with a vannamei crop, followed by black tiger and then a vannamei crop again. Almost 30-40% of farms achieve five crops in two years. The stocking density for vannamei shrimp was 40-60PL/m^2.

A priority in India is building its domestic market. Since processors prefer to focus on exports and offer little support, farmers are creating their own local fresh markets at the district level. According to Ganesh, domestic consumption has grown.

TPD, disease and high costs in Vietnam

The feed industry in Vietnam was clear that there was a gradual recovery compared to the prior year in vannamei shrimp production, but estimates on volumes differed from 470,000 to 600,000 tonnes. Export vs domestic market ratio is 70:30. The domestic sector remains significant for risk-averse farmers, absorbing fresh and mid-size shrimp grades with greater price volatility.

In the first quarter 2025, translucent post larvae disease (TPD) posed significant challenges at the hatchery and grow-out stages, according to Chewen Wei, Uni-President Vietnam Co Ltd. "Farmers lost confidence, which led to delayed pond stocking and lower stocking densities. Stocking activities gradually normalised from April. These Q1 delays affected overall annual production," said Wei. "Persistent disease and environmental issues discouraged pond restocking," said Ton That De, Viet Uc at GSF 2025. He added that lower farming success rates with survival rates down to 50% were attributed to higher density farming practices. With these risks, together with other challenges and rising costs, some have opted for fast growth genetic lines to harvest as fast as possible. In the Mekong Delta, structural transformation occurred in 2025, reported Wei. These included improved pond infrastructure, enhanced water treatment systems,

advanced management practices, and risk segmentation strategies. Both farming success rates and production stability improved in key areas. Ton estimated that soon the ratio of small farms: large farms will shift to 70:30 from the current 90:10.

Continuous low volumes in Thailand

Official data from the Department of Fisheries (DOF) showed a 0.7% decline for vannamei shrimp production to 232,807 tonnes. Industry sources gave a higher estimate of 380,000 tonnes. "Flooding in the south caused crop losses of 10–30 tonnes per farm, while cold weather in central Thailand brought down temperatures to 23-24°C and led to white spot syndrome virus (WSSV) and yellow head virus (YHV) outbreaks and reduced feed intake," said Soraphat Panakorn, President, Thailand Aquaculture Business Association (TABA).

Indonesia: Pushing boundaries

As production fell in Q4 2025, a 25-30% decrease was projected for 2025 to only 230,000-245,000 tonnes. Haris Muhtadi, CJ Feed & Care, Indonesia cited EHP and AHPND as major causes of decline in farm productivity. He added that for some farmers, the key problem was high stocking densities. In Indonesia, low density is <80 PL/m^2; median 80-150 PL/m^2 and high >150 PL/m^2 (Shrimp Outlook, 2025). In East Java, farm output improved when farmers lowered stocking density by 10-15%. They improved water quality by extending water supply intake lines from 400-500m to 1,000m.

At Shrimp Summit 2025, Haris stressed how over the last ten years, farms managed cash flow with several partial harvests, starting from 60 days until the final harvest at 115-120 days. To maintain carrying capacity, intensive farms may have 3-5 of partial harvests, periodically or when dissolved oxygen goes below 4ppm and biomass is 300-400kg/HP. "We are "pushing the environment" which is not sustainable," said Haris. New farming areas in the eastern part of the archipelago are being exploited when areas in Sumatra and Java are exhausted, allowing for yields of 50-60 tonnes/ha/crop in new farms as compared to 20 tonnes/ha/crop in the older farms.

Veering towards farming black tiger shrimp

The GSA-Rabobank Summit Survey 2025 noted that "Asian farmers are switching back to black tiger shrimp in search of better prices and farm profitability". Data showed an increase of 4% to around 650,000 tonnes, led by Vietnam at 200,000 tonnes. McIntosh gave estimates of only 538,000 tonnes for 2025 (Table 2).

"In India, black tiger shrimp output has been rising and can be expected to increase in 2026," said Ganesh. Driving India's black tiger farming revival are broodstock from Unibio (Madagascar) and Moana (USA) as well as the locally developed Nicobar line by RGCA- Rajiv Gandhi Centre for Aquaculture. CP India is using this local line to produce 150 million PL in 2025, and targets 400 million PL in 2026. Recently, Unibio has emerged as a leading producer, with around 2.4 billion PL in 2025. It is expected to produce 3.0 billion PL in 2026. The stocking density was 7-10PL/m^2 rising to 20PL/m^2. In October, farmgate prices in Andhra Pradesh, India, for size 30/kg vannamei shrimp was USD4.71/kg versus USD5.5/kg for black tiger shrimp.

Thailand's 2025 production of black tiger shrimp rose by 23.4% to 19,589 tonnes (DOF, 2025), as vannamei farmers struggled with challenges on choosing suitable genetic lines and reliable post larvae quality, prompting many to switch species. In 2025, Malaysia's total production was 42,000 tonnes at 60:40 vannamei: black tiger shrimp. As farmers faced issues with vannamei post larvae, many shifted to farming the black tiger shrimp.

Farmgate prices

In 2025, Vietnam led with the highest farmgate prices for size 60/kg vannamei shrimp. There was, however, extreme volatility, linked to supply issues. At year-end, Vietnam had the highest USD price per kg at 4.84, followed by India (3.87), Ecuador (3.09), and Indonesia (3.04, Figure 1).

According to industry, farmgate prices reflected production dynamics arising from disease outbreaks. Due to price differences, Shrimp Insights reported that YTD September, India exported 50,500 tonnes to Vietnam, likely for reprocessing. Indonesia already had the lowest farmgate prices and in August, the caesium-137 debacle, lowered these further, from USD3.97/kg to USD2.89-3.04/kg. JALA also reported lower prices (USD2.43-2.55/kg) since October.

Reactions on tariffs and recent market uncertainties

Aside from exporting head-on, shell-on (HOSO) shrimp to China, Ecuador's processors are taking advantage of its low US tariffs (10%) to capture the peeled products market. In July, value added accounted for 31% of exports to date, compared to 28% for the whole of 2024, up from 20% of exports in 2021 (Montalbetti, 2025).

The US is Indonesia's largest and most important market. At the Shrimp Aquaculture Conference 2025 (SAC), a panel noted that the industry is not ready to export to the EU because of the latter's focus on sustainability. By end 2025, Indonesia had pivoted 10% of exports to China (Shrimp Insights 2025). While exports to the US declined by 43%, India increased its exports to China (+33%) and to the EU (+58%). Value addition increased 27%. (Chacko, 2025).

Country	Black tiger production in 2025 (tonnes)
China	160,000
Vietnam	140,000
Indonesia	75,000
India	52,000
Bangladesh	35,000
Thailand	30,000
Malaysia	16,000
Philippines	15,000
Others (Taiwan, Korea, Australia)	15,000
Total	**538,000**

Table 2. Industry estimates for black tiger shrimp production (tonnes) in 2025. Source: Robins McIntosh, Charoen Pokphand Foods, Thailand.

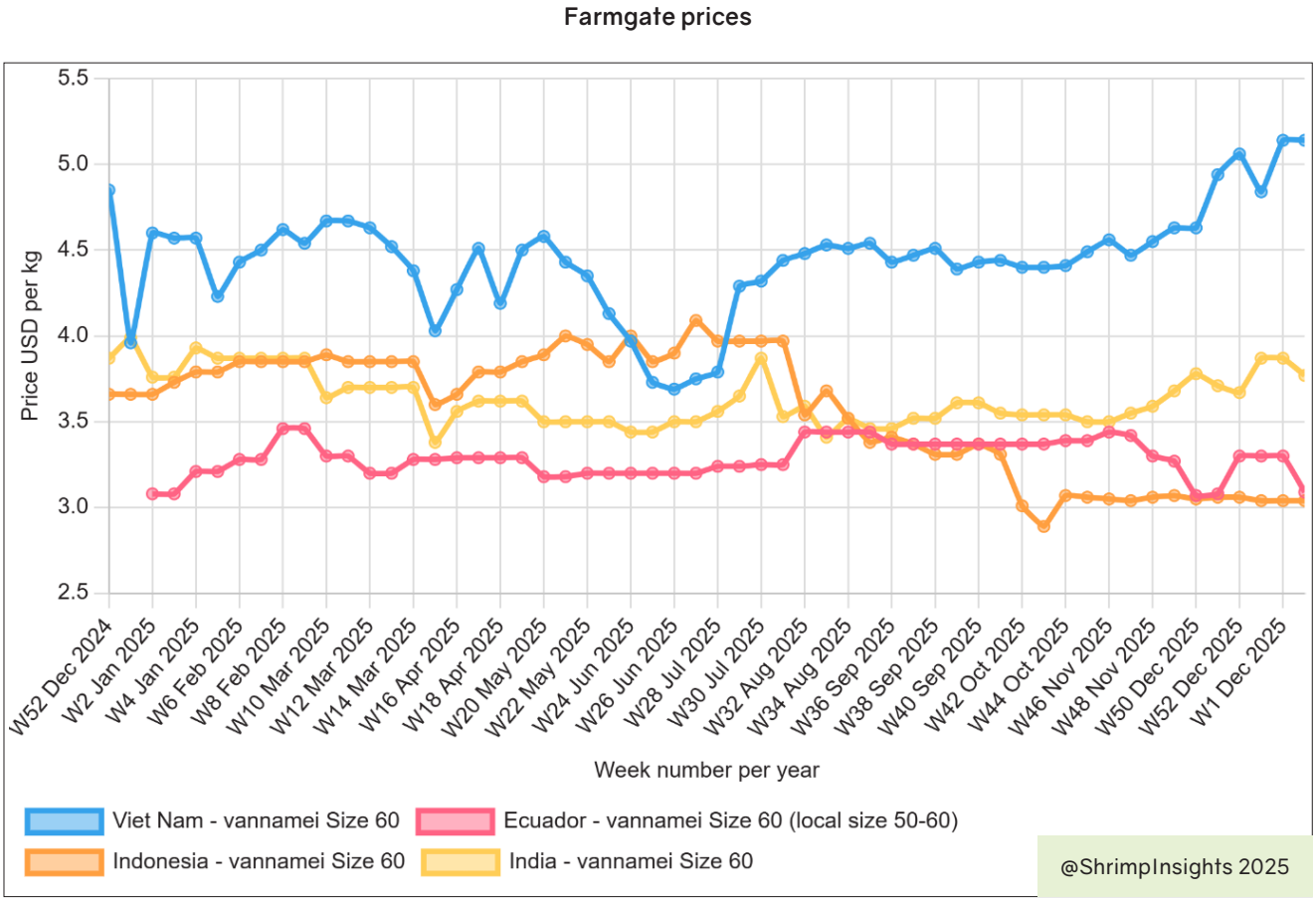


Figure 1. Vannamei shrimp farmgate prices in 2025 for Vietnam, Indonesia, India and Ecuador for size 60/kg. Source Farm Gate Price portal, Shrimp Insights (2025).

Outlook for 2026: Uncertain for Asian producers

The prospects for Asian shrimp producers in 2026 remain uncertain and highly variable across the region. An industry source expects Indonesia's production to exceed 300,000 tonnes if PT Bahari Makmur Sejati (BMS Foods), the Indonesian food processor which was flagged by the US FDA for Cs137 contaminated shrimp exports, resumes operations in early 2026.

India has reached a production milestone of one million tonnes, according to SAP. However, India must focus on increasing domestic consumption, which currently stands at just 100,000 tonnes, with a target to reach 30% of total production by 2030.

India and Indonesia have a major regulatory hurdle. Both countries are not in the approved list regarding the control on antibiotic use under the EU Regulation (2023/905). This requires all exporting countries to be in the list by 3 September 2026. Failure to be included on this list will block exports of animal-origin products, including shrimp and fish, to the EU.

Vietnamese exporters must contend with a new non-tariff barrier in the EU and UK. From 2026, major retailers will require stricter animal welfare standards. Specifically, shrimp must be completely stunned, typically through electrical methods, prior to ice immersion—replacing the traditional cold-shock approach. Leading UK retailers such as Tesco, Marks & Spencer, Sainsbury's, and Waitrose have already integrated these requirements into their procurement policies, making compliance essential for maintaining approved supplier status.

After 13 years of stagnant production, the Thai Shrimp Association has urged the government to declare a 'National Agenda' – recovery of the shrimp industry and to target 400,000 tonnes in 2026. Thailand's shrimp production peaked at 600,000 tonnes in 2011 but dropped by half in 2013 due to early mortality syndrome (EMS) or AHPND outbreaks.

Ekapoj Yodpinit, president of the association has two objectives. An opportunity for Thai shrimp to capture the US market from India, since Thailand's tariff is only 19% as compared to India's 58%. Accelerating free trade agreements with the EU, UK and Korea could recover 60,000 tonnes of lost export after Thailand lost privileges under the Generalised System of Preferences (GSP) in the EU in 2015 and recently in 2020 in the US.

In summary, 2026 will present a complex and evolving environment for Asian shrimp producers, shaped by stagnant or uneven production growth, uncertainties with tariffs, shifting export strategies, and increasingly stringent regulatory requirements in key markets.

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Shrimp Insights (2025). https://www.shrimpinsights.com/price-portal

A conversation on risk, resilience and missed opportunities

By Zuridah Merican

Balasubramaniam V is owner of the 60-acre (24ha) Certitude Farms in Tamil Nadu (above) and Secretary of the Prawn Farmers Federation of India (PFFI).

In 1994, at 24 years old, **Balasubramaniam V** started his Certitude Farms, a 60-acre (24ha) shrimp farm in Tamil Nadu. Today, he is one of India's most influential shrimp farmers and aquaculture leaders, shaping India's aquaculture policies as General Secretary of the Prawn Farmers Federation of India (PFFI). This national association represents over 100,000 shrimp farmers across the country and works closely with government bodies on policy, regulations, and farmer welfare.

Over the years, I have spoken to Bala, but I wanted to find out more about him - his passion for shrimp farming and his role in improving the industry. In November, on the sidelines of World Aquaculture 2025 India in Hyderabad, Bala shared how he entered India's shrimp aquaculture industry - the setbacks he faced, and what he wished he had done differently. Now he juggles between managing his vannamei shrimp farm which produces around 200 tonnes annually, and his leading roles in associations.

How did your interest in aquaculture begin?

I always wanted to be an entrepreneur. I did my MBA between 1991 and 1993. As part of the programme, we had to prepare a feasibility report on an industry of our choice. I was looking for a sector where I could not only complete the study, but also eventually build a business.

In the early 1990s, aquaculture in India was booming. Everyone was talking about "liquid gold" and "black gold." I was fascinated. I found a 45-day training programme offered by MPEDA on shrimp farming and hatchery management. After finishing my MBA, I enrolled, went to Cochin, visited farms, attended theoretical classes, and that was my entry into aquaculture.

How did it begin?

My very first crop of the black tiger shrimp *Penaeus monodon* in 1995 was badly hit by white spot syndrome virus (WSSV). At that time, disease awareness was minimal. WSSV had already entered India, but we did not fully understand its severity.

Production is always uncertain. You can never be sure your crop will go the way you planned. The aggressive nature of RMS is something we all need to address.

I knew aquaculture meant hard work and high risk, but also potentially high rewards. What attracted me was that while farming shrimp required time and effort, selling it was never a problem. There was always demand. But I did not expect this failure so early on.

WSSV had nothing to do with hard work or management. At that time, diagnostics did not exist. The first crop was a disaster. The second crop was also a disaster. This was an instant reality check for me. The thought of giving up did creep in, but I could not give up.

When did things finally turn around?

Our first real break came only in 2000. Disease outbreaks in Thailand and Latin America created global supply shortages, pushing prices up in India. That year, we had good survival, no disease, and in all our ponds with the black tiger shrimp, we harvested successfully. It helped us recover much of our losses, though not all.

Farming requires constant presence. It is a 24/7 job. Until 2000, I lived close to the farm. After moving to Bangalore for family reasons, the distance gradually became a strain. In hindsight, staying closer to the farm in Nagapattinam or better still, closer to my native place, Pondicherry, would have made things easier.

What were your biggest operational challenges?

Production and the lack of a good technical team. The plan was to run the farm like a business unit with professionals. We hired a consultant to design and set up the farm. After the first crop failed, he backed out. We could not find competent technicians because aquaculture was still new. Most farmers depended on themselves instead of professional staff. That remains a weakness even today.

Harvest of 60 count vannamei shrimp after 70 days of culture.

Checking the feed tray in a 2-acre (0.8ha) pond. Bala realised quickly, how hands-on he had to be.

The average pond size at Certitude Farms in Tamil Nadu is 0.8ha

In comparison, hatcheries have strong technical teams. That is why hatchery operators can scale while in farming, several farmers including myself, still struggle with this. I was naïve in thinking that I could operate the farm remotely, in a managerial capacity. I realised quickly how hands-on I had to be.

Was building a team challenging?

Finding good technicians was a big problem. I had to hire a local person - someone enthusiastic and sincere - and train him. He was not formally educated. I trained him by sending him to other farms to watch, learn, and adapt. That is how we managed things hands-on. We ran the farm with both our inputs, his and mine. When I was away, he handled operations.

Today, fortunately, I have a different team. But I still cannot say, "My technical team will take care of everything; I can relax. I am not sure if it is their technical ability or simply that farming itself has become more challenging." We did have some good crops between 2018 and 2021.

Those who have worked in large companies like Charoen Pokphand or Avanti often do better when they start farms. They understand both biology and management. That said, not all technical people are good managers. Those who develop both skills can go far.

How integrated are you along the supply chain?

I am still primarily a farmer. I occasionally dabble in domestic marketing, which I enjoy. India exports excellent shrimp, but our domestic market remains underserved.

In 2009, I started India's first prawn-focused QSR in Bangalore—PRAWNTO. The idea was inspired by the popularity of "corn in a cup." Why not "prawns in a cup"? It worked brilliantly for six months. But sustaining operations with only prawns was difficult. We added fish, vegetarian items, then chicken. Eventually, we ran out of money. The concept was ahead of its time.

You are also deeply involved in industry organisations. How did that start?

In 1996, I became joint secretary of the Nagapattinam district association. In 2007, we launched the national body, PFFI. It is pro bono work, but very fulfilling. This is the first national farmers' voice. I was elected general secretary and continue to serve until today.

What was something unique that you have done?

In 2006, when SPF vannamei shrimp was proposed for India, farmers in our region opposed it. At that time, India had mostly small and marginal farmers, while vannamei shrimp required capital-intensive farming. We feared exotic diseases.

Sample collection for shrimp disease investigation as part of the PFFI farmer-led target disease investigation program.

I represented farmers in national consultations, travelled across states, and gathered concerns. Most farmers opposed bringing in vannamei shrimp unless safeguards were introduced. This led to India establishing its first aquatic quarantine facility, with strict standard operating procedures (SOPs). That system still protects us today.

Was black tiger shrimp farming becoming a problem at this time?

Our opposition to vannamei shrimp farming started in 2006–2007 when we were still doing very well in farming the black tiger. Diagnostics for WSSV was already available. However, around 2007, loose shell disease—also called white gut disease, began affecting shrimp. By 2009, the government insisted on introducing the vannamei shrimp, as farmers were struggling with the black tiger.

We had a very sensible officer, Mr Tarun Sridhar, Joint Secretary at the time. In a meeting, everyone expected me to oppose, again. But after meeting him, I felt he understood the issues. He assured us all our concerns would be addressed. We said, "If you assure us, we won't oppose you." That's how responsible introduction happened. Today he is recognised as the key figure who enabled India's safe transition to vannamei shrimp.

What are the strengths of India's shrimp industry today?

Our strengths are a resilient, resourceful farming community and a robust hatchery sector. Their quality of production and their commitment to the sector is fantastic. Additionally, we have a lot of land available and a large domestic market completely untapped. Our exporters are well aligned with the needs of the market for value added products and have set up large capacities.

We are also seeing the emergence of second-generation operators. They are taking over land from many small farmers and consolidating them into large operations in Andhra Pradesh. They combine ten such farms into 400-acre or 500-acre (160-200ha) operations. That kind of consolidation is happening, which is particularly good.

What about the weaknesses?

With disease outbreaks, production is always uncertain. You can never be sure your crop will go the way you planned. The aggressive nature of running mortality syndrome (RMS), as has been reported over the last farming cycles, is something we all need to address.

RMS has been difficult because its causative agent is still not clearly identified. For years, RMS outbreaks were treated as a management failure and quietly sidelined. Persistent farmer feedback and continuous sampling have now shown that a pathogen is involved, prompting a collaborative disease investigation effort. Until the disease is understood in totality, it will remain a recurring problem, highlighting the need for early investigation and closer engagement with farmers rather than delayed attribution.

This has prompted a shift towards collaborative disease investigations, with continuous field sampling and closer farmer–scientist engagement. The objective is to identify causative agents early and respond before problems escalate into widespread production losses.

There is also overproduction. Prices are always a big concern. Without sufficient market, what do we do with all the volumes we are producing? A concerted push to establish a robust domestic market for shrimp to support the farming expansion is critical. Our total dependence on export markets is very risky.

There is little collaboration between farmers and research institutions; there is no national body that speaks collectively for farmers, exporters, and hatcheries. That is another major weakness; and for exporters, we lack a *Brand India* for our produce.

Do you think you can do self-regulation within your farmer association to filter out the bad apples?

As a farmer, when I buy my post-larvae, I test them before buying. I ensure quality. Likewise, when exporters buy produce from farmers, they should test the produce before buying.

More than 98% of our farmers are responsible. Our rejections for food safety are less than 1%. Weeding out that 1% is possible by self-regulation. Exporters should also test shrimp before purchase. If one or two farmers are rejected for residues, fear will come. We are talking about a small number in a country which has a highly fragmented farming sector.

Exporters must take responsibility. When a consignment is contaminated, everyone blames each other. There must be routine surveillance. If we collaborate through a national organisation, we can monitor routinely and give warnings.

In the late 1990s, when hatcheries withheld PCR results from farmers, we responded by boycotting them—demonstrating our buyer power.

In 2004-2005, the Nagapattinam Association and Tamil Nadu Coastal Aqua Farmers Federation audited every hatchery in Tamil Nadu, pushing them to ensure quality post-larvae production.

Short takes on feed, genetics, and the hatchery side of things.

Let us start with genetics. I feel these guys "missed the bus" a while back. Around two or three years ago, specific pathogen free (SPF) broodstock did a fantastic job for almost a decade. Due to overproduction, ageing ponds, and other issues, new pathogens began emerging.

Companies started pushing towards fast growth which meant less emphasis on resilience. In my opinion, that was a huge mistake. They should have stayed clear of succumbing to fast-growth pressure and maintained resilience. Today's broodstock is not resilient at all. It grows very fast, but under the slightest pressure it collapses.

When shrimp grows faster, it must moult faster. When it moults more frequently, obviously its resistance is lowered to even small weather changes. We do not need super-fast growth. Moderate growth is more than enough.

Feed remains expensive for small farmers. Imported feed can be cheaper even after duties. Hatcheries are technically sound, but genetics limit improvement.

Did you advocate the quarantine strategy for SPF broodstock?

Yes. The Aquatic Quarantine Facility (AQF) set up in 2009 and operated by the government has done a fantastic job in keeping exotic pathogens away. However, it is crucial to keep in mind that AQF can test for only known pathogens and that is why we push our government to suspend imports of any live aquatic organisms from countries farming shrimp on a commercial scale.

It is important to keep adapting and evolving import protocols to suit the current needs of the sector. Two years ago, at the first Hatch India 2023, we questioned Charoen Pokphand's Robins McIntosh and other genetic suppliers about their broodstock, which performed only in clean conditions. More than 99% of Indian conditions are not "clean" but are traditional ponds with high organic matter loads.

We had a collective understanding that breeding companies would undertake sentinel trials. They would bring all parent lines and conduct them during 2024–2025. Last week I was told that they are still waiting for government approval as the latter still does not have the necessary standard operating procedures. Now we are working together to develop guidelines and enable these trials to proceed.

What are your thoughts on marketing and branding Indian shrimp?

Our exporters have done well globally, but post-harvest handling needs improvement. Eliminating the problematic 1% would make a major difference.

We are a INR 45,000 crores (USD4.5 billion) industry. Exporters must take ownership of branding and quality. Farmers will support disease control and trials; hatcheries must fix genetics. Only collective action including on the development of the domestic market will move the industry forward.

Enhancing shrimp farming productivity through feed palatability

Applying chemosensory science to improve feed palatability has the potential to enhance the productivity, profitability, and resilience of shrimp farming systems

By Sofia Morais, Ho Gim Chong, Thiago Raggi and Romi Novriadi

Experimental nets installed in the shrimp production unit of commercial farm, CV Adi Sarana Permai in Patas Village, Gerokgak, Buleleng, Bali, Indonesia

The global shrimp aquaculture industry faces pressing challenges in optimising feed utilisation, production efficiency, environmental sustainability, and shrimp health. Shrimp are naturally slow and selective feeders, typically reared in turbid aquatic environments, which limit visibility and disperse chemical cues. These conditions seriously complicate feeding management and increase the risk of feed wastage and nutrient leaching, which in turn reduce feed quality and contribute to pond environmental degradation. Together, these factors impair feeding efficiency and decrease farm profitability.

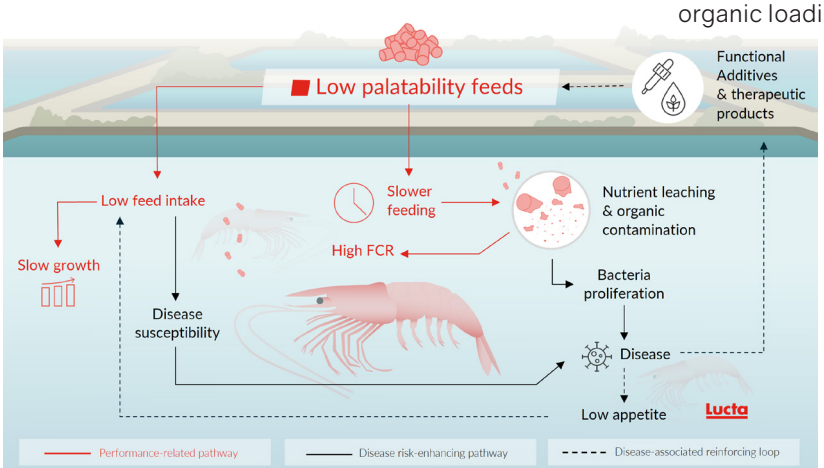
Consequences of reduced feed palatability in shrimp aquaculture

Sustainability and cost-saving trends have driven progressive reductions in fishmeal inclusion in commercial diets. While necessary, these shifts towards plant-based or lower-palatability protein sources are well known to negatively affect shrimp performance by reducing feed intake and slowing growth.

Feeds lacking sufficient concentrations of chemo-stimulants are detected more slowly and elicit weaker feeding responses. As a result, pellets remain in the water for longer periods, increasing nutrient leaching and diminishing their nutritional value. This contributes to a deterioration in feed conversion ratio (FCR) and, ultimately, in growth performance.

In parallel, uneaten feed and leached nutrients increase the organic load in the pond. Excess organic matter promotes the proliferation of heterotrophic and opportunistic bacteria, including *Vibrio* spp., thereby increasing microbial pressure and challenging shrimp health. Shrimp experiencing inadequate energy and nutrient intake while being exposed to unstable water quality become immunologically compromised and more vulnerable to disease.

Together, these factors create a performance-reducing pathway that becomes interconnected with a disease risk-enhancing pathway, as shown in Figure 1. Finally, if opportunistic diseases break into the system, shrimp appetite is further reduced, and the use of functional additives or therapeutic products, many of which can themselves lower palatability, further enhances a downward spiral in farm productivity. Improving chemosensory stimulation breaks this negative cycle by enabling faster feed detection, greater feed intake, more efficient nutrient utilisation, and a reduction in pond organic loading.



"When incorporated into feeds, these additives enhance the chemical "signature" of pellets, facilitating quicker detection, faster ingestion, and more consistent feed intake."

Figure 1. Potential consequences of low palatability feeds in shrimp farming, including conceptual interrelations between performance-related, disease risk-enhancing and disease-associated reinforcing loops.

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Feeding
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and gut sensing

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Chemosensory science to the rescue: Using chemical cues to drive intake

Shrimp possess highly sensitive sensory receptors distributed across their bodies, enabling them to detect chemical cues and locate food from considerable distances. Extensive research into chemo-stimulants and their role in chemosensory-driven feeding behaviour enable the identification of substances that reliably trigger attractability and feeding responses in shrimp. From a chemical point of view, they are low molecular weight and water-soluble substances, which are commonly present in high concentrations in shrimp's preferred prey. These molecules dissolve rapidly in water and form chemical plumes that can be detected through long-range (antennule-driven) and short-range (legs and mouthparts) chemosensory pathways.

This knowledge has enabled the development of sensory additives as mixtures of active ingredients and chemicals that target the activation of the shrimp's chemosensory systems. When incorporated into feeds, these additives enhance the chemical "signature" of pellets, facilitating quicker detection, faster ingestion, and more consistent feed intake. Ultimately, chemosensory-targeted palatability strategies can increase feed utilisation efficiency while reducing nutrient losses to the water.

Efficacy of a palatability enhancer in low fishmeal diets

To validate the concept illustrated in Figure 1, a comprehensive 81-day trial was conducted at the shrimp production unit of a commercial farm, using juvenile *Penaeus (Litopenaeus) vannamei* with an initial mean body weight of 2.27 ± 0.10g. Shrimp were stocked at 300 shrimp per pen into 3 × 2 × 1m net pens. Environmental conditions remained stable throughout the trial, with an average water temperature of 30.6°C, salinity of 25.8ppt, and dissolved oxygen of 7.5mg/L. A standard fixed feeding rate protocol was applied, decreasing from 7% to 5% of biomass as shrimp grew.

Six dietary treatments were evaluated, each assigned to six replicate pens. The positive control (PC) diet contained 15% high-quality Peruvian fishmeal, 15% poultry by-product meal and 25% soybean meal as main protein sources. In the negative control (NC), fishmeal was reduced to 7.5% and soybean meal increased to 34.9%; lysine and methionine were supplemented to maintain essential amino acid balance, and corn starch was reduced.

Four additional treatments were formulated by supplementing the NC diet with 0.075%, 0.1%, 0.125% or 0.15% of a palatability enhancer (PE; Luctamax® AQ, Lucta). All diets were isoproteic (around 38.5% CP), while crude lipid levels ranged from 5.2–5.6% in NC and PE diets compared to 6.3% in the PC treatment.

Growth performance

Growth declined markedly in shrimp fed the NC diet relative to the PC, confirming the negative impact of reduced fishmeal inclusion (Figure 2A). However, supplementation with the PE restored growth in a clear dose-responsive manner. Inclusion levels of 0.1% or higher not only compensated for the 50% reduction in fishmeal but significantly improved growth beyond that of the PC group. The strongest response occurred at the 0.125% supplementation level. Feeding efficiency had a similar response as growth (Figure 2B). Survival remained high across all treatments (>90%) and was not influenced by diet.

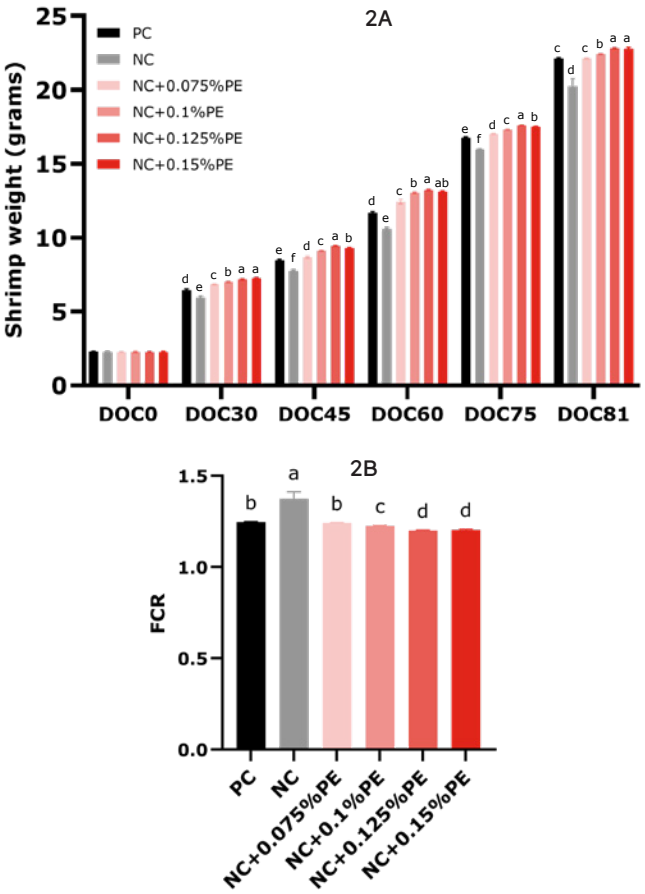

Figure 2. Performance of shrimp on a diet containing 7.5% fishmeal (NC), or a similar diet further supplemented with 0.075% to 0.15% of a palatability enhancer (PE) from Lucta (Luctamax® AQ). A diet containing 15% fishmeal was used as a positive control (PC). 2A shows shrimp weight (g) change during the experiment; 2B shows feed conversion ratio (FCR) at the end of the 81-day trial.

Shrimp find the palatability-enhanced feed faster

The trial included a behavioural attractability test that measured latency-to-contact, defined as the time required for 10 shrimp to approach and make initial contact with the feed. Shrimp offered the PE-supplemented diets exhibited markedly faster responses: latency decreased by up to 168% compared with the negative control and by 155% relative to the positive control. As with growth performance, attractability improved in a clear dose-dependent manner (Figure 3). This pronounced reduction in latency confirms that the PE effectively stimulated rapid chemosensory detection and stronger feeding motivation.

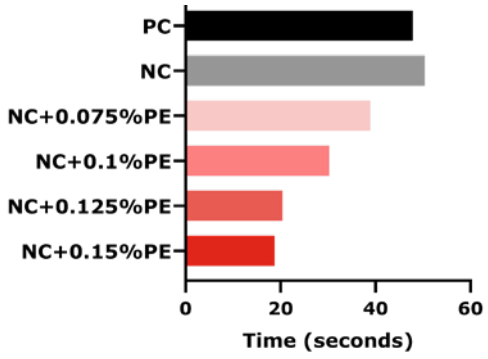

Figure 3. Attractability response (latency-to-contact time, seconds) to experimental diets. Diets were 7.5% fishmeal (NC), or a similar diet further supplemented with 0.075% to 0.15% of a palatability enhancer (PE, Luctamax® AQ). PC is a positive control with 15% fishmeal.

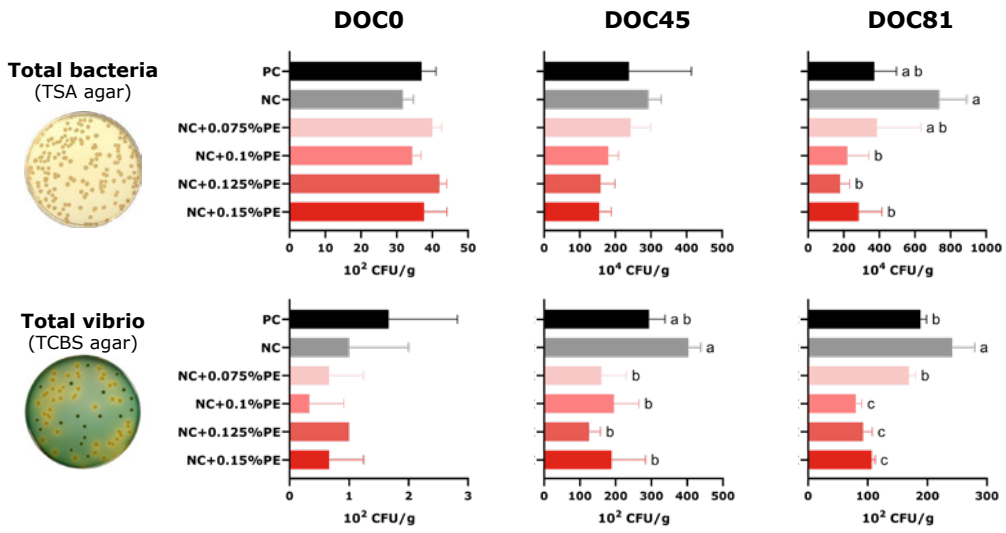

Figure 4. Total bacteria and total *Vibrio* spp. counts in shrimp hepatopancreas at day of culture (DOC) 0, 45 and 81 of the trial. Similar trends were observed in shrimp intestine (not shown). Diets were 7.5% fishmeal (NC), or a similar diet further supplemented with 0.075% to 0.15% of a palatability enhancer (PE, Luctamax® AQ). PC is a positive control with 15% fishmeal.

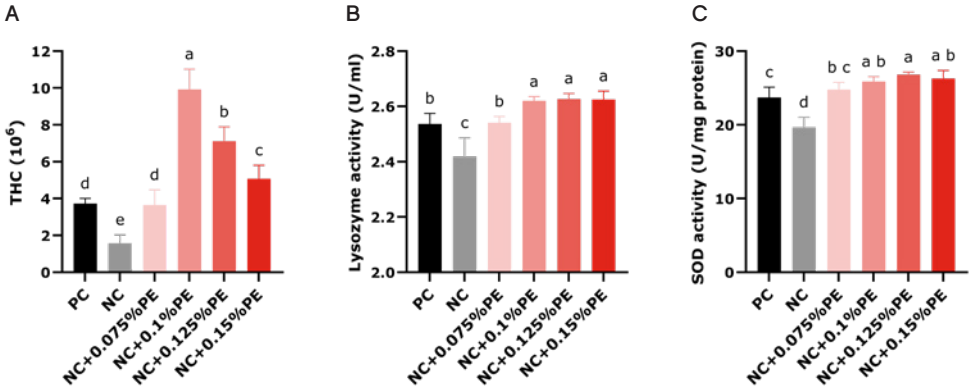

Figure 5. Health status indicators at the end of the 81-day trial. A- total haemocyte counts (THC) in haemolymph; B - lysozyme activity in plasma; C - superoxide dismutase (SOD) activity in hepatopancreas. Diets were 7.5% fishmeal (NC), or a similar diet further supplemented with 0.075% to 0.15% of a palatability enhancer (PE, Luctamax® AQ). PC is a positive control with 15% fishmeal.

Microbial load reduction and health biomarker responses

Microbiological analysis of the hepatopancreas and intestine revealed that, by the end of the trial, shrimp fed the PE-supplemented feeds had significantly lower total bacteria and *Vibrio* spp. counts compared to the NC, especially at ≥ 0.1% inclusion levels (Figure 4). These improvements likely reflect the combined effects of faster feed detection and consumption, which reduce nutrient leaching and lower organic loading in the culture system - conditions that limit bacterial proliferation and colonisation of feed pellets.

Shrimp physiological robustness was evaluated using several key health indicators, including total haemocyte counts (THC) in haemolymph (Figure 5A), lysozyme activity in plasma (Figure 5B), and superoxide dismutase activity in hepatopancreas (Figure 5C), representing cellular immunity, humoral defense, and antioxidant capacity, respectively. These parameters demonstrated significantly improved health status across all PE-supplemented treatments, and more substantially at ≥ 0.1% inclusion levels, which even exceeded the PC treatment.

Conclusion and implications for industry practice

Sensory feed additives such as palatability enhancers are emerging as essential tools supporting the use of alternative ingredients, with positive impacts on the industry's sustainability, productivity and profitability.

The trial presented here demonstrates how these strategies help break the negative cycles illustrated in Figure 1. In addition to stimulating feed intake and promoting growth, palatability enhancers contribute to lower organic waste burden and reduce microbial pressure in the feed and farming environment, by enabling a faster detection and consumption of feeds. As a result, they promote healthier, more robust shrimp, and contribute to more resilient farming systems.

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A new dimension for a human health postbiotic: Gut health strategy in shrimp

dsm-firmenich launched its postbiotic product GutServ® at World Aquaculture 2025 India in Hyderabad. On November 13, Zuridah Merican sat down with the Animal Nutrition & Health team of Philippe Tacon, Product Manager - Microbials and Benedict Standen, Head, Aqua Marketing Global, to discuss the development, application and limitations of this postbiotic feed additive originally developed for human health and now adapted for shrimp aquaculture

In Hyderabad at the launch, dsm-firmenich's Animal Nutrition & Health team, Philippe Tacon (right) and Benedict Standen.

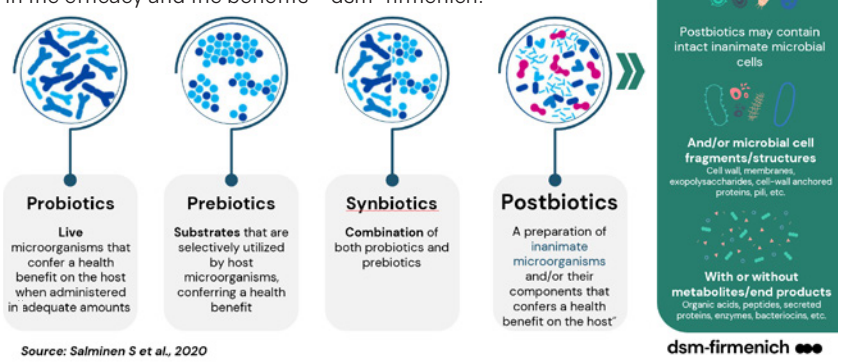
In 2023, dsm-firmenich acquired Adare Biome, for its leadership in research and manufacturing of postbiotics. The acquisition aimed to drive their "Health from the Gut" strategy to innovate next-generation biotics for people and animals.

Adare Biome is a pharmaceutical company, which had developed this postbiotic product for gut health initially for human use," explained Philippe Tacon, who joined dsm-firmenich from Adare Biome. He has been working on bringing the product to aquaculture over the last four years.

Tacon explained, "However the history of the product goes back much further. It was first discovered by a French doctor in the early 1900s. Simplified, he isolated a bacterium, a *Lactobacillus*, from the stools of healthy human patients and developed it as a treatment for diarrhoea, particularly in children. He also developed a process to ferment the bacteria and stabilise it using heat to market them as tablets."

What was later discovered is that the product is actually a symbiotic combination of two bacteria, mainly *Limosilactobacillus fermentum* and *Lactobacillus delbrueckii*, grown together. "Today, the product is sold by dsm-firmenich for human gut health under the name Humiome® Postbiotic, and in animal nutrition under the name GutServ® Biotix. It has been launched in Europe for piglets and today, we are launching it for aquaculture," added Tacon.

Figure 1. Prebiotics, probiotics and synbiotics relative to postbiotics. With postbiotics, all the components are involved in the efficacy and the benefits - dsm-firmenich.



Source: Salminen S et al., 2020

What exactly makes this product different from probiotics?

Tacon explained, "The uniqueness in this postbiotic is that we have two bacteria grown together in the same fermentation - not separately; then they are mixed. This allows interaction during the fermentation process itself. After fermentation, the product is heat-treated at 120°C for one hour, which inactivates the bacteria but preserves their beneficial properties. This makes it a very stable and flexible product with a long shelf life."

Another important difference is that unlike typical probiotics where the bacteria are separated from the fermentation medium, this product retains the metabolites released during fermentation.

"It is important to understand that this is a highly structured process," said Standen. "Specifically, the heat inactivation process is carefully controlled to ensure the beneficial properties are preserved. The product's mode of action, therefore, relies on two components: the inactivated bacterial cells and the metabolites produced during fermentation. We are currently working on isolating and characterising these metabolites, and the activity we are discovering is quite interesting."

Where does this product sit among prebiotics, probiotics and synbiotics?

In the microbiome space, you have prebiotics, probiotics and synbiotics, which are combinations of pre- and probiotics (Figure 1). Many of the probiotic and synbiotic products in its portfolio are the result of its acquisition of Biomin several years ago.

Tacon, strongly asserted, "This product is unique. It is a postbiotic, meaning it does not depend on live bacteria. It is sourced from Adare Biome. We believe the same core mechanism works across species. We see efficacy in piglets, shrimp, fish and poultry. The concept remains the same." The team assures that each batch undergoes quality control similar to the

ones applied in the pharmaceutical industry to ensure consistent quality and efficacy.

How does the postbiotic work in shrimp?

GutServ Biotics, which is formulated to enhance gut integrity and functionality, is effective in shrimp. "Based on our work so far, there are three main pathways. First, it is delivered through the feed and reaches the gut, where it helps improve the gut microbiome and immune function, and has strong anti-inflammatory and antioxidant properties," explained Standen.

He added that considering the current shrimp farming environment - in particular disease pressure, environmental fluctuations, unpredictable rainfall, stress from handling and transfer, the goal is to improve the robustness and resilience of the shrimp, so the animal can better help itself. "It is similar to how we take supplements or postbiotics during stressful periods."

What trial results have you seen so far?

There have been extensive *in vitro* work using cell lines to understand the mode of action, as well as laboratory trials. "We have shrimp trials conducted with partners such as ShrimpVet, IMAQUA and others. In trials with AHPND (acute hepatopancreatic necrosis disease) we observed a 30–38% improvement in survival under pathogenic challenge, 16% improvement in survival against white spot syndrome virus (WSSV) and around 37% improvement in survival under osmotic stress, such as sudden rainfall,"' summarised Standen (Figure 2A and 2B).

"We are addressing bacterial, viral and environmental stressors simultaneously. At the same time, we are feeding fish in our European research facilities to build the value proposition in fish with plans to launch next year."

On at which stage should the postbiotic be used, Tacon responded that they are still generating data on constant versus pulse feedin. "The product does appear to work best in early life stages, similar to what we see in piglets and poultry."

However, Standen noted that usage also depends on the nature of the challenge. "If the critical period is the first 30 days, that is where the health intervention is most important. Dosage strategies can also vary, perhaps higher inclusion early on and lower inclusion later to balance efficacy and cost."

What are the regulatory challenges with this product?

Tacon said, "A major advantage is that the product is considered a feed ingredient, not a veterinary drug. In Europe, it does not require registration. In Thailand and Vietnam, no registration is required for aquaculture use, but import permits are needed. We have just obtained approval in Taiwan"

However, India and some other countries will require registration, while markets like Indonesia and China are more complex since the product is considered as a feed additive.

Standen is optimistic about the product's future, outlining plans to expand into Europe and Latin America next year, with the eventual goal of achieving global reach. He noted that the favourable regulatory profile simplifies international expansion.

Why did you start with Asia for aquaculture?

Standen noted, "Shrimp was a logical starting point to build the value proposition. Farmers in Asia are facing severe health challenges, including WSSV and white faeces disease (WFD). Yesterday, I heard that farmers are often harvesting for 40 days and suffering heavy losses. We felt the industry is clearly in need of effective health solutions."

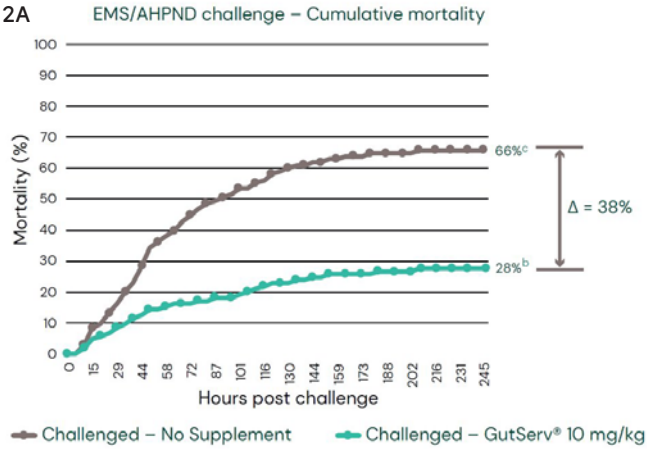
The team agreed that the industry is crying out for health solutions, but the issue is convincing farmers to use the product as there is a cost element.

How do you convince the primary customer, the feed miller, to use the product?

The postbiotic's primary customer is the feed miller and since the recommended inclusion rate of the pure product is only 10–40g per tonne of feed, it is a challenge when dosing.

Standen said, "We also offer diluted premixes (containing vitamins, minerals, amino acids and feed additives) to make application easier for feed mills without micro-dosing systems. With micro dosing equipment, it is simpler as it can be added directly. We also work with other premix houses if customers do not use DSM premixes. The product remains stable regardless.

2A



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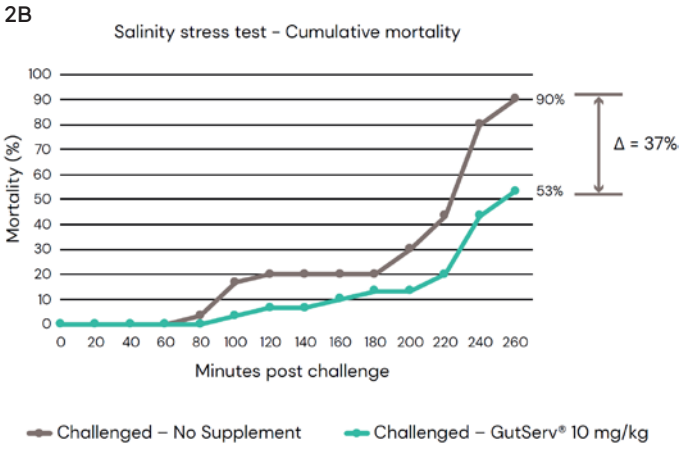

Figure 2A. Total survival at day 10 following an immersion challenge with EMS positive *Vibrio parahaemolyticus* at 1.5x10^5 CFU/mL in shrimp fed 10mg/kg GutServ® versus control (no supplementation). **Figure 2B.** In an abiotic salinity challenge model, survival under osmotic stress in shrimp fed 10mg/kg GutServ® versus control (no supplementation). Adapted from "Harnessing postbiotics for sustainable health management in shrimp aquaculture" by Roy Rosen, Ester Santigosa and Philippe Tacon, dsm-firmenich, presented at Aquaculture Europe 2025, September 22-24, Valencia, Spain .

"An important advantage is that unlike probiotics, this product survives pelleting and extrusion temperatures. Feed millers get the functional benefits of a probiotic without the risk of killing live bacteria during processing."

The team's objectives align with that of feed millers. If the farmers succeed, the feed millers succeed. They will get repeat business and stronger customer retention. The industry is competitive so measuring the return on investment (ROI), in terms of reduced FCR, and survival rates help. Feed additives also allow feed millers to differentiate themselves in a highly competitive market where macro-ingredients are largely the same.

Tacon added, "There has been a longstanding interest by feed millers to add probiotics in feed. Other than that, there is the convenience of this product, not requiring extra equipment, its safety, and the availability of premixes."

At present, the core strategy remains through feed mills. Standen said, "At this show, we have farmers asking about this product. Therefore, we are exploring top-dressing solutions for on-farm use which would be more diluted and easier to apply. Farmers already use probiotics in pond water mainly for bioremediation. This product is different as it is designed to act directly on the animal."

Are farmers confused about feed additives?

Standen responded that in general, this is the case, with many additives on the market claiming very similar benefits. This makes it difficult for farmers to differentiate.

"At dsm-firmenich we try to be guided by science. For a specific challenge, you may need a postbiotic - for another challenge, a probiotic and for others, different solutions. We try to build on that foundation."

Another challenge with top-dressing is application. Mixing any product on feed can change pellet quality. Pellets can become sticky, block automatic feeders, affect palatability, or lead to leaching. The best strategy is always to include the product directly in the feed so that every pellet contains the same amount and the product is homogeneously distributed.

How do you address the scepticism of some farmers who claim these products are not consistently effective?

Tacon was clear, "These products are designed to address challenges. If there is no challenge on the farm, you may not see a visible effect. But they also function as protection or insurance when challenges arise. That said, even the best product will not work if farm management is poor. You can have the best feed in the world, but without good feeding management, good water quality, good genetics and proper farm practices, it will not deliver results."

Standen added, "We are not claiming that this product is a solution to every problem. Often, when people say a product is not working, the root cause is management, poor water quality, incorrect feeding, or incorrect usage. However, the farmers may insist that feed is to be blamed."

What is the potential for improper applications?

With top-dressing, workers may not apply the correct dosage or mix properly. When results are not achieved, the product is blamed. "When we dive deeper, the issue is often that SOPs were not followed. However, if farmers fail, we fail. We win and lose together. Our technical teams work closely with farmers every day to share knowledge, improve feeding practices, water management and overall farm performance," said Standen.

A challenge at the moment is cost. The stand is, "We do not present it as an added cost, but as value. If a product improves survival, growth or productivity, it is an investment, not a cost. We target a minimum ROI of 3:1. If a farmer invests one dollar in our product, we expect at least three dollars in return through improved survival or growth."

As a proactive function, how do farmers know which disease it protects against?

Tacon noted that it is not a magic bullet, and it does not guarantee protection against every future challenge. "That is why we test the product across multiple stress models, bacterial, viral and osmotic challenges. It functions like health insurance. In reality, disease will come at some point. However, this product helps improve resilience."

"Compared to poultry, shrimp farming is far less standardised. In poultry, 95% survival is expected. In shrimp, 50% survival can be considered acceptable, and survival can vary dramatically from pond to pond," said Standen.

"In some respects, aquaculture, particularly shrimp, is many years behind poultry. However, there are lessons to learn. Feed additives are well established in poultry; the question is not whether to use them, but rather which one and from which company. Functional feeding in shrimp is still relatively new, and trust takes time to build.

"Feed additive companies have a real responsibility. There are honest, transparent companies that share data and explain limitations. At dsm-firmenich, we are prepared to do this. We encourage customers to ask questions, request information and understand what a product can and cannot do."

What is your long-term vision for this product and for shrimp nutrition?

The team mentioned salmon farming where around 20–30% of feed called "functional feed," are used strategically at specific life stages.

"Shrimp has not reached that level of maturity yet. Our vision is for shrimp nutrition to move in that direction, using the right solutions at the right time, supported by data and transparency.

"This is not only about this product, but about raising standards across the entire industry, encouraging questions, data-driven decisions and responsible use of feed additives."

Final thoughts

"Now being part of dsm-firmenich allows us to fully develop its potential with strong R&D support. We believe it can play a meaningful role in improving shrimp resilience and are looking forward to wider adoption as the industry continues to evolve," concluded Tacon.

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Marketing krill-based nutrition for shrimp health and performance

At World Aquaculture (WA 2025) in Hyderabad, India, premier sponsor, Aker QRILL Company highlighted research on the use of krill-based functional ingredients in shrimp farming. The focus was a study conducted in India on *Enterocytozoon hepatopenaei* (EHP), which illustrates how the ingredient can support shrimp growth and performance while improving health outcomes and reducing disease-related losses

Krill (Euphausia superba) Credit: Aker QRILL Company

Aker QRILL was previously part of Aker BioMarine until September 2024. It is now a speciality company focusing on the sustainable harvesting of Antarctic krill (*Euphausia superba*), a small, shrimp-like crustacean found in the Southern Ocean, and on the development of krill-based ingredients for nutraceutical, aquaculture, and aquafeed applications. QRILL Aqua is the premium marine ingredient designed specifically for the aquaculture sector.

A conversation with the team – **Kiranpreet Kaur** (R&D Director, Fish Health and Nutrition), **Bjoern Wallentin** (SVP Global Sales), and **Atul Barman** (Managing Director, India) – centred on krill meal, the science behind it, its role in mitigating EHP, how to effectively collaborate and communicate its value to users, and how to integrate krill-based nutrition into farming practices.

The dual role of krill meal

As a feed additive or ingredient, what are the best inclusion rates in shrimp feeds?

Kiranpreet Kaur (KK): We can debate the inclusion levels based on the target functionality. At a lower limit of 1%, krill meal acts as a performance enhancer and increases palatability.

However, to fully realise the value of QRILL Aqua – its functional properties related to health, robustness and resilience – the inclusion level should exceed 3%. In an EHP infection, the microsporidian targets only the hepatopancreas, utilising nutrients and preventing shrimp from growing. Shrimp become weaker and eventually die. In our EHP study, we observed that at 6% inclusion, survival improved, and shrimp coped better with the infection.

This demonstrated the role of krill meal in enhancing hepatopancreatic function, improving nutrient uptake, and boosting health. Therefore, at a 6% inclusion level, we can almost mitigate the effect of EHP. But it is important to clarify that it is not a cure.

Bjoern Wallentin (BW): We could also argue for gradual inclusion rates – 1%, 2%, 3%, and then above 3%. As an additive, benefits can be seen even at below 1 to 2%, but this is not ideal. Environmental issues can hamper growth or increase mortality, thus masking the benefits.

We can say that including it consistently provides advantages—shrimp grow better and have higher survival rates. Scientific studies suggest that adding krill meal may result in a 5 to 7% improvement in growth or health. However, adverse environmental conditions can make these benefits hard to observe and measure.

Atul Barman (AB): The hepatopancreas is a crucial organ in shrimp. After an EHP infection, increasing the amount of krill meal in the feed helps the remaining functional portion of the hepatopancreas utilise nutrients more efficiently and can completely mitigate the pathogen's negative effects.

What about the cost element to the farmer for a proactive strategy?

BW: It is admittedly costly for farmers to use 6% krill meal in shrimp feed continuously over a 15-week cycle. Therefore, we suggest feeding it for 6-7 weeks after EHP detection. Adjusting the feed protocol can help recover the crop and achieve a marketable harvest.

KK: Farmers have various levels of measurements and we acknowledge that it's difficult to tease out the effects of the krill meal when environmental conditions cloud the results. However, to be proactive and prevent diseases such as EHP, farmers will need to increase krill meal inclusion.

From research to market: Positioning product attributes

Which functionality of krill meal would the R&D team push to market?

KK: R&D works in two ways: identifying market problems and finding solutions or exploring the intrinsic value of the product and where science can take it. For EHP, we saw QRILL Aqua's impact on the hepatopancreas functionality and immune health, making it a strong fit.

A conversation with the team: Kiranpreet Kaur (R&D Director, Fish Health and Nutrition, middle), Bjoern Wallentin (SVP Global Sales, left) and Atul Barman (Managing Director, India).

We have external collaborations. It helps when an external scientist believes in the product attributes. There is also the business aspect, whether it gives a good return on investment and also feasible from the R&D side. We aligned closely on these when deciding the next steps.

BW: R&D provides the full overview—where the product works and what happens. The marketing team can then select what suits the market. Initially, we consider two possible paths and choose by consensus. We questioned whether krill meal could help with EHP, and if so, we needed the science. The results were overwhelmingly positive, making alignment across R&D, sales, and marketing straightforward.

AB: From a field perspective, R&D gives us the push once evidence is available. In India, our trial clearly demonstrated efficacy at different dosage levels. We then work with customers to get them to try and assure them how to get the best out of krill meal in shrimp health.

Which to choose: palatability, performance enhancer or health intervention?

KK: My advice is a market-specific approach, balancing growth, health, sustainability, and economic outcomes. In Ecuador, optimal conditions allow for faster shrimp growth, so palatability is the priority. In India, mitigation of EHP is paramount, so we highlight the functional benefits of krill meal.

BW: The shrimp industry needs animals that are robust, resilient, and consistently high in quality. This is crucial for sustainability. While growth is important, shrimp health must be prioritised. Unhealthy shrimp raise food safety concerns.

Field validations

What difficulties arise when conducting shrimp trials to confirm laboratory results?

KK: In the laboratory, benefits are straightforward since we only need to focus on the physiology of the hepatopancreas, unlike in salmon where multiple organs and processes must be examined. But in the field, it will not be easy to tease out the effects.

Feed formulations differ all over Southeast Asia, – Vietnam, Thailand, Indonesia–so results from India may not fully translate to these countries. We anticipate needing trials in multiple countries.

Openness and data sharing

KK: Feed producers closely guard their formulations, preferring to conduct their own testing and maintain autonomy over recipe development. When they are open, we collaborate with them because reformulation with krill meal must be done correctly. We provide access to our extensive database, which contains detailed information on various batches and the unique nutritional profiles.

BW: Krill composition varies seasonally. In winter, krill are slimmer, higher in protein, and lower in fat. In summer, they consume more algae and can be up to 30% fatter. Instead of focusing solely on protein, we want nutritionists to recognise krill's inherent phospholipid content, which plays an important role in hepatopancreatic health.

AB: In India, feed producers have technical teams engaging with farmers. It is important that the correct message is communicated—not that krill meal is simply an expensive ingredient.

B2B: Working with feed millers to reach farmers

BW: Our product has benefits but it is only a small component of the feed. We now need to bring laboratory results to the field. We will work with feed millers, our direct customers to give us more control on the whole process.

Feed millers are the ones selling the product to the farmers and so we need to make sure that they understand the benefits of the feed and communicate this well to the farmers. They invest as much as we do, so alignment is essential. We also need to bring in the broader value chain - buyers and exporters and finally showcase the value of krill meal to the consumer.

Sustainability metrics

How has krill meal sustainability improved?

KK: We enhance sustainability through efficiency of operations - harvesting krill more efficiently and reducing the carbon footprint. We reduce fuel consumption by using remotely operated 6-7m drones and unmanned harvesting vessels equipped with sonars to collect data, and we use AI integration for precise harvesting. Eco-harvesting eliminates bycatch, and a vacuum system brings live krill on board to preserve their nutritional quality. Rapid processing prevents autolysis by the krill's highly active digestive enzymes. We continuously refine each step to reduce energy consumption.

BW: We use nitrogen as a preservative, allowing krill to be stored at a wide range of temperatures, so as to reduce dependency on continuous freezing. We monitor environmental impacts from harvesting onwards and optimise logistics to reduce energy use, thus contributing to our life cycle assessment (LCA).

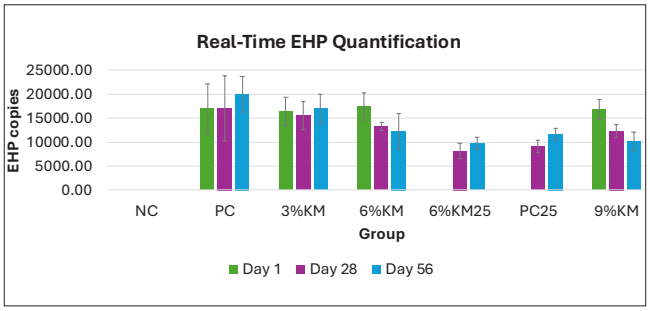

Figure 1: A notable reduction in EHP copy number was observed in krill meal (KM) -fed shrimp compared to the control group, indicating an improved ability to cope with EHP infection. KM was included in feed at 3%, 6% and 9%. NC=negative control and PC=Positive control. Adapted from the presentation "Dietary krill as a nutritional intervention for *Penaeus vannamei* shrimp infected with *Enterocytozoon hepatopenaei* (EHP)" by Uma Arumugam, Victor Suresh and Kiranpreet Kaur, presented at World Aquaculture 2025 India, Hyderabad, India, November 10-13, 2025.

Sustainability of krill meal as a feed ingredient

How do you address stakeholder concerns about the sustainability of krill meal in aquafeeds?

BW: Critics often overlook stringent regulations and the vastness of the krill population. The Antarctic region is divided into sectors, with commercial fishing allowed only in Sector 48. The total biomass there is estimated at 5–6.4 million tonnes, while the harvest quota is approximately 0.9% of biomass — 620,000 tonnes of live krill—equivalent to just 0.2% of the total estimated biomass. Only a tiny fraction is harvested, ensuring long-term sustainability.

Krill meal in Indian aquafeeds

With cost as a primary concern, how should krill meal be positioned?

AB: Indian aquaculture faces persistent challenges, particularly cost pressures. Feed millers recognise the value of krill meal. At low inclusion, it improves palatability and growth; at higher levels, it delivers health benefits. On the value proposition, we differentiate the market: smaller-and medium-sized feed millers focus on providing low-cost feed. A premium feed comes at a premium price. However, there is a difference between costly and expensive–the value added exceeds the cost.

BW: Krill meal is often considered a "functional feed", used when farmers face challenges, such as overall health, juvenile stages, pre-harvest stress or colour enhancement. Feeding with krill meal increases feed intake in stressed shrimp. Early feeding with krill meal helps shrimp grow stronger. The functional benefits far outweigh the extra cost.

Trust between farmer and feed miller

BW: Under controlled conditions and changing parameters one at the time, we can easily measure performance. In the field, farmers face multiple interferences and find it difficult to visualise improvements. Furthermore, their expectations could be higher.

KK: Krill meal provides a good combination of different nutrients. It is not a fish meal replacer. A 1:1 replacement of krill meal: fishmeal does not work. Field trials show that adding krill meal incorrectly can weaken the diet.

Today, we focus on educating both the feed producers and the farmers, asking them to look at the different nutrients from krill. Then, they can add it in a proper way, with the right inclusion levels starting with balanced diets.

Driving decisions: Nutrition or sustainability

Which is the main factor in buying decisions?

KK: Feed producers get both, the functionality aspects and sustainability. The latter is becoming more important for Aquaculture Stewardship Council (ASC) certification. They understand the needs and use krill meal as part of their ASC certification strategy.

BA: Certification is a business need. As a corporate brand, some companies want to be associated with sustainability. Both are growing in India. There is greater awareness and stricter enforcement of certification.

Feedback on the product

What do shrimp and salmon producers say about krill meal?

KK: Salmon producers regard krill meal as a functional ingredient at various stages throughout the production cycle. When salmon is under stress, producers have observed benefits such as improved immune health, greater resilience, and overall enhanced organ function. Krill meal used during pre-slaughter enhances the quality of the final product. Producers note better pigmentation and superior fillet quality in salmon.

Feed conversion ratio (FCR) is common across species. However, because krill meal is used intermittently as a functional ingredient rather than throughout the whole production cycle, FCR data is fragmented.

BW: In RAS systems, the goal is high digestibility. One customer observed that including just 0.5–1% krill meal improved FCR by 0.1. Priorities differ by production method. Recent Nofima research showed krill is a rich natural source of the super osmolyte trimethylamine-N-oxide (TMAO), beneficial for fish robustness during stressful periods such as winter or seawater transfer. Marine fish need water to stay hydrated, and krill is the best single component to help their internal osmosis system.

Vision for the future

KK: From a research perspective, my goal is to enhance awareness of krill—its value, unique characteristics, and optimal usage—so users can fully realise its benefits. Although krill is costly, the advantages far outweigh the expense. It is about cost–benefit, not just price.

AB: We are aligned with R&D and want the industry to understand and utilise krill's benefits through feed millers, ultimately supporting farmers. Even small inclusions can increase yield, reduce disease outbreaks, and improve profitability.

BW: Our responsibility is to simplify a complex picture. Customers need to understand the value of krill. A 1–6% inclusion can deliver 94–99% of the value. In the future, aquafeeds should move away from raw materials that are used for human food, and krill meal can support palatability. I hope for greater willingness from stakeholders to understand and pay for these benefits.

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Feed additives for productivity and environmental stewardship

Remembering the need for cholesterol in shrimp feeds and positioning plant sterols

By John Grayson

Over the past three decades, the global shrimp industry has shown remarkable growth. Production volumes have increased fivefold, from 30 tonnes per hectare to 150 tonnes per hectare (Mai Chung, 2025). Today, global shrimp production has reached approximately 5.5 million tonnes, according to Rabobank (2024). The majority of this production originates from two key regions: Asia and Latin America.

This rapid advancement has been driven by improvements in genetics, the adoption of innovative technologies, the industrialisation of farming practices, enhanced disease prevention strategies and the development of precise nutritional solutions.

Sustainability: The path forward

Nevertheless, the industry faces growing concerns regarding sustainability, including the conversion of natural land for aquaculture, excessive use of antibiotics and chemicals, discharge of polluted water into surrounding ecosystems and the overreliance on fishmeal. Since 1980, feeds for shrimp have become the largest consumer of fishmeal, accounting for approximately 25% of global fishmeal usage (IFFO, 2022). Additional challenges have emerged in recent years, such as market oversupply, declining prices and the rise of new diseases.

Despite these challenges, sustainability remains a fundamental pillar for the continued development of the shrimp industry and its long-term viability. As a global leader in animal nutrition, ADM is deeply committed to promoting sustainability, particularly through nutritional innovation.

In shrimp feed formulation, ADM emphasises the importance of balancing rapid growth performance with environmental responsibility. This involves incorporating more sustainable ingredients that minimise ecological impact. Key trends in sustainable nutrition include the use of organic minerals, phytogenics, yeast-based products, probiotics and plant sterols.

To enhance farmer efficiency and promote sustainable practices, ADM has developed a specialised feed solution for *Litopenaeus vannamei* (whiteleg shrimp), supporting both productivity and environmental stewardship.

Importance of sterols in shrimp feeds

One unique challenge when formulating shrimp feeds is the essential nature of cholesterol as a nutrient. Cholesterol plays key roles in cellular structure, tissue lipid transportation and the regulation of lipid metabolism. It is also the essential precursor molecule to an assortment of steroid hormones that regulate moulting, energy use and reproduction (Kanazawa, 2001). Crustaceans cannot synthesise cholesterol from smaller molecules, and they need sources of it in their feed to support growth and health (1- 2.5g/kg diet for optimal growth, depending on species/life stage).

Traditionally, formulators have met the cholesterol requirements of shrimp by including a myriad of cholesterol-rich ingredients in diets, such as fish and squid oils and fishmeal. As the feed industry shifts away from animal-source ingredients, the risk of cholesterol deficiency has become a major concern in recent decades (Chen et al., 2023). While some mitigating solutions have been adopted over time (e.g., phospholipid products and bile acids to increase bioavailability), meeting the cholesterol requirements of shrimp continues to be a costly endeavour.

Plant sterols as a cholesterol alternative

One potential solution for meeting the cholesterol requirements of shrimp that has not been widely explored is the incorporation of plant sterols into feed formulations. Plant sterols are similar to cholesterol in molecular structure and serve similar functions in plant tissues. Several research studies suggested that plant sterols have similar growth and health-promoting effects on shrimp as animal cholesterol (Chen et al. 2023b; Guo et al., 2020).

A recent study from ADM evaluated the supplementation of practically formulated, extruded test diets with no additional sterols (basal diet), 1g/kg of cholesterol concentrate (>92%), or 1g/kg of plant sterols concentrate (>95%) and their effects on whiteleg shrimp growth performance and body composition.

Shrimp were distributed to RAS tanks and fed one of the three experimental diets for 62 days (~0.5g/shrimp starting weight to 10-15g/shrimp final weight). The supplementation of the basal diet with either sterols source led to significant improvements in weight gain and feed conversion ratio (FCR) during the feeding period (Figure 1).

There were no statistically significant differences in growth performance between shrimp fed cholesterol supplemented and plant sterols supplemented diets. Shrimp fed with the plant sterols supplemented diet had a similar concentration of cholesterol in hepatopancreas tissues as those fed with the cholesterol supplemented diet, which suggests that shrimp can convert some fraction of plant sterols into cholesterol to meet their needs. The results of this study suggest that plant sterols can support the same growth benefits as cholesterol in practical shrimp feeds with better cost efficiency.

The plant sterols advantage

With issues of cholesterol nutrition continuing to challenge feed formulators, ADM has developed Plant Sterols AN, a highly concentrated plant sterols product (>95% total sterols) that can help meet the cholesterol requirements of shrimp with cost efficiency. This is a dry powder with high processing stability, a highly stable formulation, and a long shelf life. When added to shrimp feeds, this product can support fast growth and feed

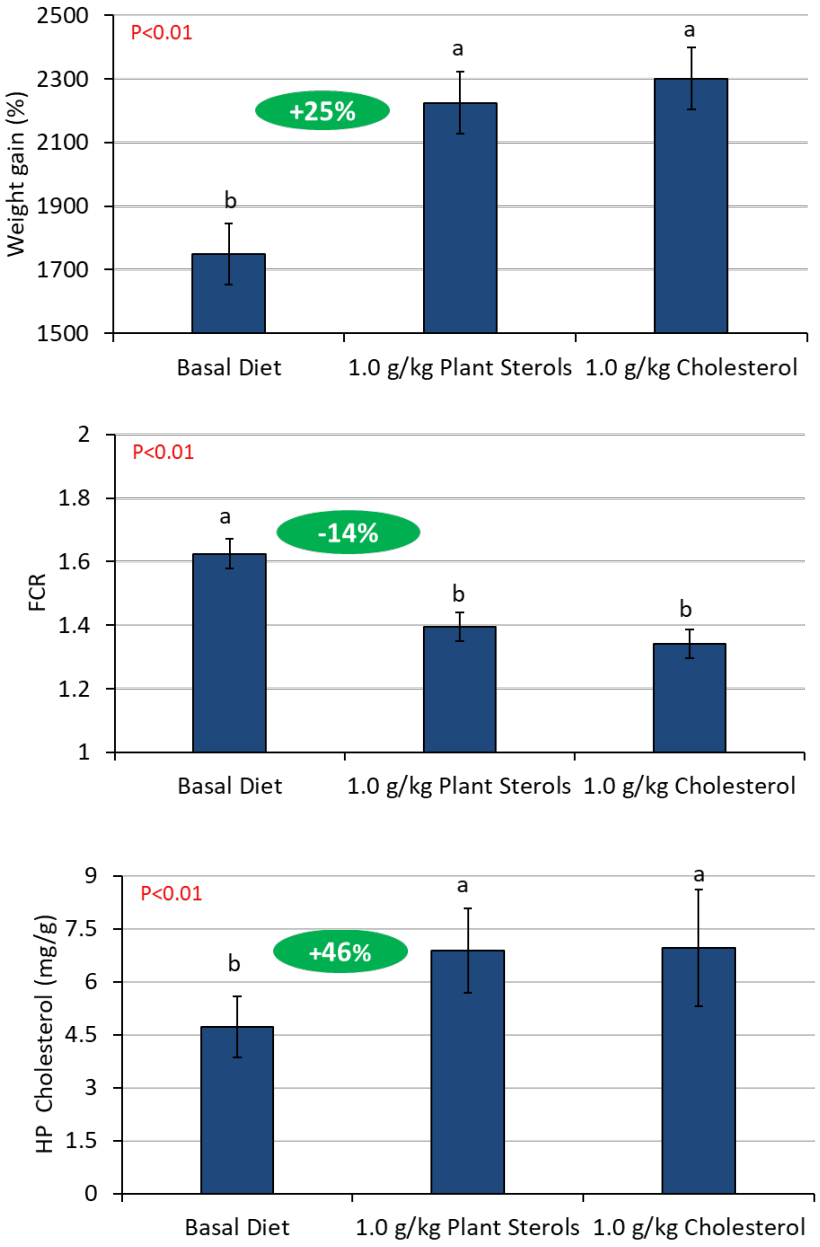

Figure 1. Total weight gain (%), feed conversion ratio (FCR), and hepatopancreas (HP) cholesterol concentrations (mg/g) of whiteleg shrimp *Litopenaeus vannamei* after 62 days of feeding on practical test diets with supplemented plant sterols or cholesterol.

utilisation while allowing formulators the flexibility to shift away from cholesterol-heavy macro ingredients. The product will be available from ADM's animal nutrition business in Vietnam in early 2026.

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A strong focus on sustainability in feed production

Backed by R&D in feed digestibility, Alltech Coppens is pushing ahead with more plant and land animal byproducts and achieving lower carbon emissions throughout the feed production process

Alltech Coppens operates in two countries: the Netherlands, which is home to its headquarters in Helmond and a feed R&D centre in Leende; and Germany, with a feed production facility in Nettetal. The company produces a wide range of high-performance aquafeeds, from starter to grow-out, that are tailored to various species and production systems. Alltech Coppens is especially strong in starter feeds for trout, marine feeds and feeds for farming in recirculating aquaculture systems (RAS), as well as in open ponds and cages. Its other feeds include those for eels, African catfish, sturgeon, the hybrid catfish (*Clarias gariepinus* x *Hetrobatrachus*) and ornamental fish. The company's marine fish feeds are formulated for seabass, seabream and *Seriola* sp.

In 1993, three Dutch shareholders established Coppens International to produce fish feed. Two years later, with an extruder, the company became a specialist in fish feeds for temperate species. However, while the feed mill stayed busy in the summer, business slowed down in the winter. Coppens' next move was to begin producing top-quality ornamental, specialty and bait feeds for hobby fish to deliver in the spring. By 2016, after almost 24 years, Coppens International had earned a strong reputation for being an innovative, high-quality aquafeed producer with a strong production infrastructure, located right in the heart of Europe.

Alltech came into the picture in 2016, when the late Dr. Pearse Lyons, founder of Alltech, was on the lookout for a feed mill. On a trip through Helmond, he visited Coppens' aquaculture research centre (now known as the Alltech Coppens Aqua Centre, or ACAC), and within 3 hours, he decided that he was interested in acquiring the company. With Coppens, Dr Lyons saw opportunities in the fish nutrition business: a robust, quality production system; dynamic routes to market; and a pioneering spirit for R&D — which, all combined, present numerous opportunities for synergy.

Dr Lyons also acquired a 51% stake in Guabi in 2016, and that company was fully integrated into Alltech in 2019. Guabi, headquartered in Brazil, produces 80% of its feed for tilapia, and the other 20% are extruded shrimp feeds. In 2023, Fennoaqua, Finland's only fish feed production facility and a pioneer in producing RAS feeds, became part of Alltech. It has the capacity to produce 50,000 tonnes per year, with 95% of its feeds formulated for trout.

While Coppens International became part of Alltech in June 2016, it was only in the summer of 2018, as it celebrated 25 years, that the company was rebranded as Alltech Coppens and added a third extrusion line. For Ronald Faber, who joined Coppens in 1994 and now serves as Alltech's global Aqua lead and CEO of Alltech Coppens, it was important to be part of the Alltech family.

"For years, we have been setting the tone in the aquaculture sector," said Ronald. "Our specialists ensure innovative and high-quality feed ranges. We use our expertise to create the perfect feed tailored for each fish species at all stages of their growth. Our fish nutrition business is based on four pillars: palatability, performance, pollution control, and the planet."

Large SKUs and addressing farmers' needs

The Alltech Coppens factory in Nettetal, Germany, has the capacity to produce 60,000 tonnes per year with three extrusion lines. The facility employs 85 personnel, with 60 involved in feed production. Its smallest extruded pellet is 1mm and the largest is 28mm — the latter of which are heavyweight pellets packed with a high oil and protein content for maximum attraction for feeding large-sized fish, such as catfish, carp and sturgeon, in Europe. The highest fat level in their feed is 33%, and in starter feeds, 52% crude protein is common.

The feed plant has around 400 SKUs, including nine feed sizes for trout; feeds supplemented with Alltech's proprietary ingredients — such as Bioplex, Sel-Plex, Mycosorb and Actigen — to enhance feed efficiency, immune function, gut health, water quality and mycotoxin mitigation; and feeds designed to counter environmental and disease challenges in farming.

Ronald noted that his team has created specialised feeds, such as those formulated for winter conditions, when feed intake and digestibility are lower, and feeds that reduce skeletal deformities in sturgeon.

"The way we work is that we put the farmer in the centre of everything," he said. "As a large company, we offer support with mycotoxin analysis and fish health management.

Ronald Faber, who joined Coppens in 1994, is now Alltech's global Aqua lead and CEO of Alltech Coppens.

We have developed a boost concept to help farms with parasite issues, which proved effective with seabream in Malta and is being adapted for other species."

Three drivers: Automation, digestibility and sustainability

"Our feed plant is fully automated, and we are one of the most automated companies within the group," said Ronald, who added that the factory has three shifts per day over a 6-day week. "From our raw material contracts, through pricing, planning, warehousing and bagging, we are fully automated and do not like to work with paper. A forklift driver scans to collect and deliver feed bags."

Quality control is done by the production and quality assurance team, which looks at every single batch.

"There is basic analysis on the NIR and physical inspection, and when acceptable, we will book and open a silo for unloading," Ronald explained. "The wet analysis of raw materials and end products are completely outsourced, and two days later, we have the results. All analyses are directly connected to the Bestmix formulation software."

With changes in raw materials, there are still physical inspections of quality and colour.

"Each department has their own KPI boards," said Ronald. "Each shift works on the principles of operational excellence, which include respect, safety, quality, sustainability and efficiency. The goal is to produce a targeted amount of extruded feed of the right quality per week. Under specification material is around 4%, so we have more with starter feed as compared to finished feeds."

According to Ronald, the best investment Alltech Coppens has made at the feed plant is a fully automated dosing machine for powders and liquids, which are added into the mixers, reducing staff exposure to airborne particles and ensuring precision and consistency.

Formulated with no fishmeal

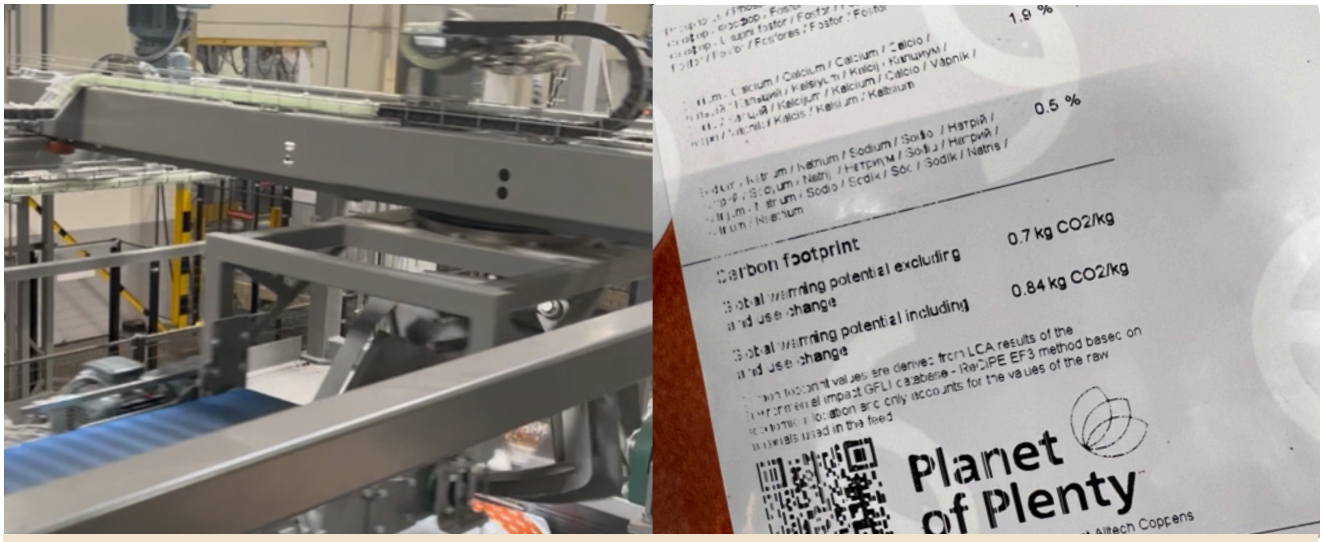
Ronald explained that fishmeal and oil were phased out of Alltech Coppens' feed production five to six years ago, and the current focus is on sustainable alternatives, such as plant proteins. Only 2–3% fishmeal is used in high-performance trout feeds. Algal oil has generally replaced fish oils, except for the recent temporary return to fish oils due to cost. Ronald noted that algal oils are not expensive when calculated based on their eicosapentaenoic acid (EPA), docosahexaenoic acid (DHA) and vitamin D content. However, when based on energy values, feed formulators will avoid them.

Currently, the production of GMO-free feeds is a critical need. "We decided not to use soy and to seek replacements with plant meals with sustainability credentials," said Ronald. "Unfortunately, insect meals do not present good life cycle assessment (LCA) metrics. We only use European poultry meals, the sources of which are clearly defined. In the future, I can see that single-cell proteins could be good replacement ingredients for soy, but scale and bacteria modification may be needed."

Feed digestibility

While palatability could be a primary concern with low fishmeal inclusions in feed, at Alltech Coppens, palatability tests of the diets indicated otherwise. There are checks on the digestibility of every single raw material as well. This allows for formulations on a net-energy basis.

1mm extruded starter feeds and a 28mm pellet for fishing catfish, carp and sturgeon in Europe.



Left, a robotic palletiser arranges feed bags 3x2 at the Alltech Coppens feed mill in Nettetal, Germany. Right, the feed bags include information on the feed's carbon footprint, with or without land use.

Leading the research for feed nutrition and additive business

The Alltech Coppens Aquaculture Centre (ACAC) sits on 11 hectares in Leende and houses the company's R&D facilities, both indoor and outdoor. Here, the focus is on *in vivo* feed digestibility, with conical tanks equipped with faeces collectors in seven specialised RAS-based trial systems. The research conducted at the ACAC is solely for the company's feed nutrition and additive business. It has also hosted trials for its sister feed mill, Alltech Fennoaqua. The total system can be adapted for trials for freshwater and marine species at high and low temperatures.

Dr Vivi Koletsi, a global technical support specialist who joined Alltech in 2023, said that the entire system was rebuilt in 2017, just a year after Alltech acquired Coppens International. A recent new addition — a mini RAS system separated from the main system — allows the research team to work only on water quality changes. Growth trials are currently underway studying young sturgeon and the digestibility of sea bream feeds, summer feeds and winter feeds for the trout at 20°C and 6° C, respectively.

"The optimal temperature for the trout is 12–16°C, and so we expect stress to affect feed digestibility," said Vivi.

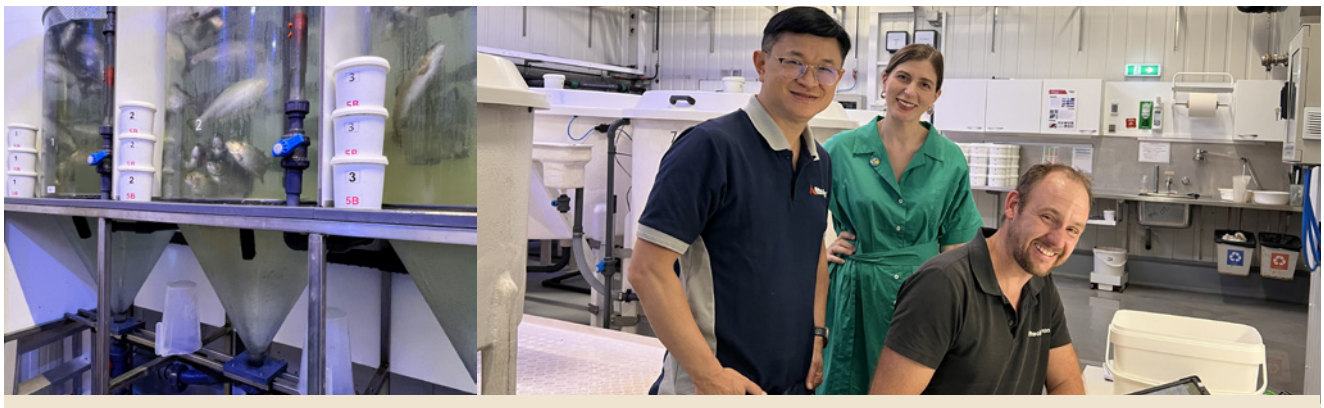
Sustainability at the heart of production

Over the last couple of years, Alltech has set up internal teams working on sustainability, drawing on staff from all over the world to ensure the proper representation. The feed plant is now ASC, Global Gap, ISO14.001, ISO15.001 and ISO50.001 certified. In February, Alltech Coppens was awarded a Platinum Medal from EcoVadis, which assesses business sustainability.

"This demonstrates our dedication to sustainability across the entire value chain," said Ronald. "We have implemented robust initiatives to reduce environmental impacts, promote fair labour practices and foster ethical business conduct. On every feed bag produced, there is information on the carbon footprint of the raw materials, with or without land use.

"We also buy green energy, which comes 100% from solar and wind energy," Ronald continued. "The dryers use gas, and the next step is electrification."

Additionally, Maud Valkenaars, researcher at the ACAC, is conducting a PhD. project in collaboration with Stirling University of Scotland on the use of LCA tools to quantify the sustainability of fish feed and aquaculture production along the full value chain for farming rainbow trout (*Oncorhynchus mykiss*) and African catfish (*Clarias gariepinus*).



Left. Conical tanks evaluate the digestibility of winter diets fed to trout at 6°C.
Right. Technicians at the Alltech Coppens Aqua Centre have many years of experience conducting research. Rudi Looijmans, who has 23 years of research experience is shown here collecting and counting uneaten pellets as part of a growth trial with trout (right). On the left is Dr Henry Wong, Alltech's regional commercial development director of aquaculture for Asia and Dr Vivi Koletsi, global technology support for Alltech's Technology Group.

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Sustainable eel feeds

A new venture for the company is extruded feed for eels, which makes Alltech Coppens one of two feed millers for eel feeds in Europe. Supported by the European Union through the European Maritime Fisheries and Aquaculture Fund, the company is developing a sustainable eel feed that can reduce by half, the amount of wild-caught fish needed to produce eel feeds.

"Eels have specific nutritional requirements, such as feeds with high levels of high-quality fishmeal and fish oil," Ronald noted. "Because of their short digestive tract and picky eating habits, replacing fish-derived ingredients in eel feeds is extremely difficult."

In collaboration with Wageningen University, the ACAC will lead the development and testing of this low-fishmeal, low-oil feed by taking an innovative approach. Developing a new eel feed with a 50% lower forage fish dependency ratio (FFDR) that still works to maintain eel health and growth, will help secure both the future of the eel as a species and the sustainability of the eel farming industry.

Clean emissions

At the Alltech Coppens factory located near the village of Nettetal, Germany, it was essential to install effective odour and air emissions controls for the feed-processing operations. The company made a significant investment in a fully biological, self-maintaining system that uses sprinklers to keep the filters moist.

Dual marketing strategies

Feeds are sent to 70 countries. "There are direct sales to what we call our home markets — individual customers in Germany, France, Belgium, the Netherlands and the U.K.," said Ronald. "In terms of volumes, Europe is very important for us."

The company's ornamental feeds, which are high-end feeds for carp, are sold through retail batching with an associated company, and there is no branding for this segment.

Beyond Europe, through distributors, Alltech Coppens has a strong foothold in Central Asia for trout and sturgeon feeds, as well as in West Africa. Nigeria is a leading nation in farming the African catfish (*C.gariepinus*) and the fast-growing Hetero-Clarias (*C. macrocephalus* x *C. gariepinus*).

"Nigeria is our biggest market in Africa, especially for starter feeds for catfish, where our market share is 80–90%," Ronald noted.

Viewed from the rooftop of the feed plant, this fully biological and self-maintaining system allows for clean and odour-free emissions. Sprinklers continuously keep the biological filters moist.

Optimising omega-3 nutrition for enhanced shrimp health and human nutrition

By Robert Redman

Global aquaculture production continues to grow and is shaping the future of how the world is fed (Figure 1). As aquaculture expands, farmers face intensifying pressures from disease outbreaks to environmental stressors to meeting consumer expectations for healthy, sustainable seafood. Underneath these challenges lies a simple but powerful truth: better nutrition supports stronger, more robust animals.

Among the most critical nutrients for many aquaculture species are the long-chain omega-3 fatty acids, eicosapentaenoic acid (EPA) and docosahexaenoic acid (DHA). Traditionally supplied by fish oil, these fatty acids

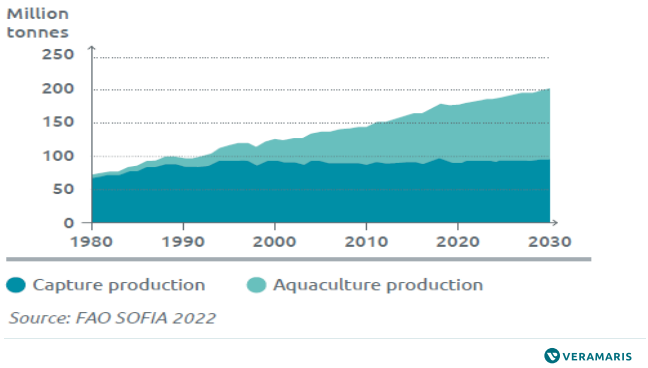

Figure 1. Aquaculture leads growth in seafood production.

influence everything from growth and immunity to the final nutritional value for consumers. However, global demand for EPA and DHA across aquaculture, human health, and pet food is rapidly outpacing sustainable supply (Figure 2). This pressure has accelerated the need for alternative sources of these omega-3s to deliver reliable levels of these essential nutrients.

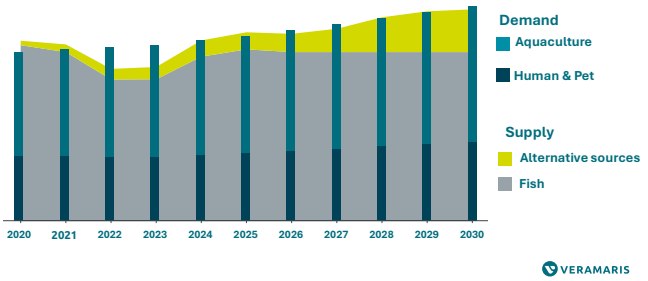

Figure 2. EPA & DHA supply and demand imbalance.

Why omega-3s are the unsung heroes of shrimp health

There are a number of scientific studies confirming that EPA and DHA are essential for shrimp, supporting improved production efficiencies, shrimp performance and health and welfare. This research is summarised in the Optimum Omega Nutrition Guidelines published by Veramaris (OON for Shrimp - Veramaris).

However, we want to know more! To continue building on this existing research and further understand the impact of elevated dietary omega-3 levels on shrimp physiology and performance, Veramaris has commissioned several research trials.

In the trial reported here, three experimental diets were formulated to evaluate immune competence, stress resilience, and product quality in Pacific white shrimp (*Litopenaeus vannamei*). The diets were:

- CTRL: 0.4% EPA + DHA (fish oil)
- 1% High Blend (HB): ~1% EPA + DHA (fish oil + algal oil)
- 1% High Algae (HA): ~1% EPA + DHA (algal oil only)

Shrimp (0.6g) were reared for 56 days under controlled laboratory conditions. Post-trial assessments included challenges with *Vibrio parahaemolyticus* (AHPND), acute salinity stress tests, immune cell profiling, and muscle fatty acid analysis.

The immune story runs deep: Stronger cells, stronger animals

Shrimp, unlike mammals and fish, have no adaptive immune system. There are no antibodies waiting in the wings. Their entire defence relies on innate immunity - specifically haemocytes and granulocytes. Think of them as patrol officers and tactical responders keeping the shrimp's internal "city streets" safe.

AHPND is one of shrimp farming's major challenges, capable of causing mass mortality events and costing the industry an estimated USD43 billion globally. In the trial, shrimp fed 1% EPA+DHA diets showed up to 23% lower mortality (Figure 3). Shrimp farmers often endure disease losses as a routine risk, but this trial shows that elevating the levels of EPA+DHA to support shrimp health can improve their survival which translates directly to a farmer's profitability and sustainability.

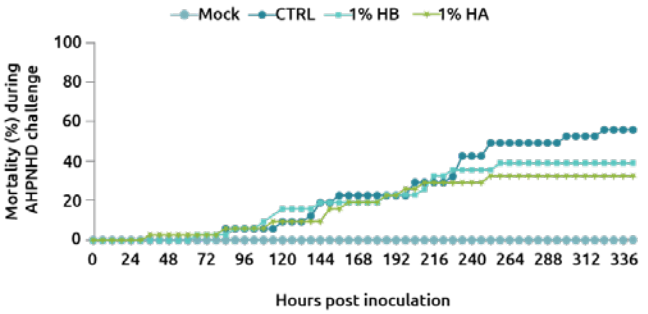

Figure 3. Cumulative mortality following AHPND challenge. Diets were CTRL: 0.4% EPA + DHA (fish oil); 1% High Blend (HB): ~1% EPA + DHA (fish oil + algal oil) and 1% High Algae (HA): ~1% EPA + DHA (algal oil only).

Rapid and acute salinity stress is another persistent challenge in shrimp aquaculture and results showed that shrimp fed higher omega-3 diets experienced a delayed onset of mortality, indicating stronger immune response and robustness (Figure 4).

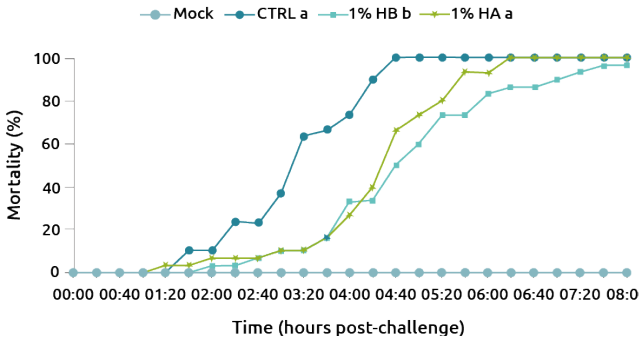

Figure 4. Cumulative mortality following an acute salinity stress. Diets were CTRL: 0.4% EPA + DHA (fish oil); 1% High Blend (HB): ~1% EPA + DHA (fish oil + algal oil) and 1% High Algae (HA): ~1% EPA + DHA (algal oil only).

Immune profiling revealed that raising dietary EPA+DHA levels from 0.4% - a level typically seen in commercial diets - to 1%, led to an increase in total haemocyte counts by 26-54% and a significant increase of 29-51% in granulocytes (Figure 5). These are the shrimp's cellular "first responders" and granulocytes in particular, are essential for pathogen recognition and elimination, preventing infections from spiralling out of control.

In short, investing in better nutrition to support heathier animals makes sense!

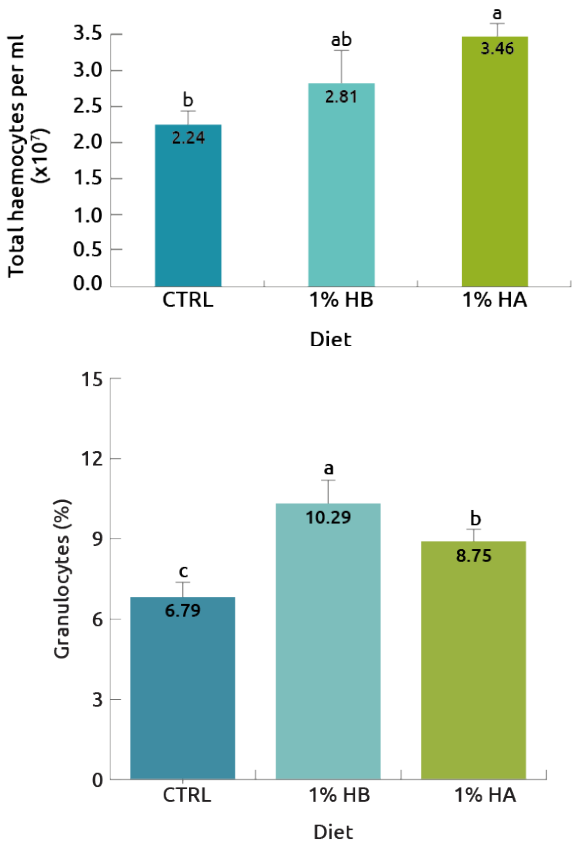

Figure 5. Immune profile showing number of haemocytes (top) and granulocytes for each diet (CTRL: 0.4% EPA + DHA (fish oil); 1% High Blend (HB): ~1% EPA + DHA (fish oil + algal oil) and 1% High Algae (HA): ~1% EPA + DHA (algal oil only)).

Health benefits that go all the way to the consumer

The positive effect from Optimum Omega-3 Nutrition does not stop at the farm! EPA+DHA are vital for human health, responsible for brain development, cognitive and eye function, cardiovascular health, and our own immune responses.

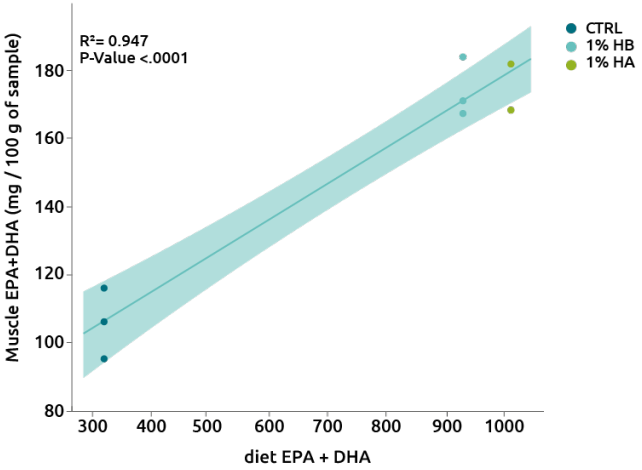

Figure 6. Correlation of EPA+DHA in the diet and deposition in the shrimp tail muscle. (CTRL: 0.4% EPA + DHA (fish oil); 1% High Blend (HB): ~1% EPA + DHA (fish oil + algal oil) and 1% High Algae (HA): ~1% EPA + DHA (algal oil only)).

This study highlighted that shrimp fed 1% EPA+DHA diets showed a linear increase in fatty acid deposition in their tail muscle - from around 100mg/100g in the control group to about 180mg/100g in the enriched diets (Figure 6). This is a significant improvement in nutritional density at a time when consumers increasingly buy seafood for the health benefits associated with EPA+DHA.

With the American Heart Association recommending 250-500mg EPA+DHA per day, omega-3-rich shrimp can help consumers meet their dietary intake needs naturally and sustainably.

Better nutrition pays

From the data gathered in this study, it is clear that better nutrition is an effective strategy in shrimp farming! The evidence is clear; elevating EPA+DHA from 0.4% to 1% strengthens innate shrimp immunity, improves resilience to biological and environmental stress, supports higher productivity and profitability for farmers, all while increasing the nutritional value for consumers too.

Feeding shrimp optimum omega-3 levels is no longer just a feed formulation decision - it is a strategic investment in future-proofing the farm, improving farmer livelihoods, and meeting the expectations of seafood consumers.

Nutrition is not just about growth. It is about building a stronger, more resilient, more sustainable shrimp industry - one cell at a time.

Robert Redman is Market Development Manager at Veramaris Asia Pacific.
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Halieutica: Inside France's CRO in shrimp feed research

Guillaume Le Reste (left) and a part of the Halieutica team, Eva Rondeau, scientific manager (middle) and Jean Luc, quality management consultant.

From a small beginning eight years ago, the Centre for Experimentation on Aquafeeds in Crustacean or CEAC by Halieutica, in the quiet outskirts of Angers in France's Pays de la Loire region, has evolved into a distinctive contract research organisation (CRO). For founder Guillaume Le Reste, an aquafeed nutritionist, Halieutica was born not from long-term planning but from crisis.

"When COVID-19 shut down borders and halted international business, I lost most of my consulting work in Asia and South America." Instead of waiting for the world to reopen, he pivoted. "I had to find another business. Clients couldn't run trials anywhere. Everything was closed. So, I decided to build my own small-scale research station and offer trials to our main French customers so that they do not lose time and can restart marketing when the world reopens."

What began with 12 aquariums and a handful of vannamei shrimp has since grown into a purpose-built facility with three specialised research rooms, a team of dedicated scientists, and a growing global reputation.

From garage to research hub

Halieutica's early days were humble. The first R&D station operated out of Le Reste's garage, and the first employee worked from the family kitchen. But demand grew quickly. European feed additive companies—often focused first on salmon before turning to shrimp—needed reliable, affordable, and scientifically robust shrimp trials. Few facilities existed in Europe.

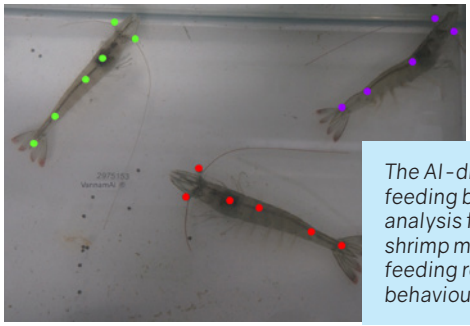
Halieutica filled a gap: a shrimp-only research platform focused on feed performance, digestibility, and behaviour, designed for ingredient suppliers, feed mills, and additive producers. Today, the facility includes:

- A growth trial room with 80 tanks for high-replication experimental designs
- A behavioural analysis room equipped with video-based AI tracking
- A digestibility room using innovative faeces-collection methods adapted for shrimp.

"We can test additives, ingredients and feeds from every angle," said Le Reste. "The idea is to provide customers with data on their products (enzymes, probiotics, pigments, insect meals, etc.), to substantiate their claims. In Europe, there are clear frameworks and companies must show proof of concepts using standard protocols."

A new frontier: AI-driven shrimp feeding behavioural analysis

The most groundbreaking development at Halieutica is led by Eva Rondeau, who heads the shrimp behaviour program. What began as hours of manual video observations has evolved into an AI-powered system capable of tracking individual shrimp movements, feeding responses, and behavioural patterns.



The AI-driven shrimp feeding behavioural analysis tracks individual shrimp movements, feeding responses, and behavioural patterns.

"We use AI (artificial intelligence) to analyse how shrimp interact with feed," Rondeau explained. "We can see whether an ingredient or formulation affects palatability or attractability."

The system works by:

- Recording 5-minute feeding videos
- Tracking each shrimp using machine learning
- Mapping movement patterns and time spent in feeding zones
- Measuring speed, frequency, and duration of feeding attempts
- Combining behavioural data with pellet weight loss to quantify consumption

"We adapted an open-source ethology software originally designed for mice and mosquitoes to shrimp with the team at Angers University. After more than 100 hours of human-annotated video, the AI can now reliably identify individual shrimp—even when multiple animals overlap," added Le Reste. "Most of the earlier work was carried out with Kera, a keratin hydrolysate produced by BCF Life Sciences, France. Marketed as a functional amino acid source, the company wanted data on its palatability in shrimp."

Rondeau said that to date, they can generate heat maps of shrimp activity around the pellets and have attractability metrics showing how fast shrimp locate feed. "While VannamAi software can show the palatability indicators, i.e. how long they stay and how much they eat, in contrast, there are also repellent detection for ingredients or drugs that deter feeding."

While the team has not yet consolidated these into a single key performance indicator (KPI), the dataset is already transforming how feed additives are evaluated. In a presentation at the recent Aquaculture Europe 2025 in September, the team studied the palatability and attractability potential of brewery spent yeast (BSY), well known for immunity properties. Recorded videos were analysed with the software to generate data on palatability and attractability based on data on prehension, speed, time spent in the feeding zone, shrimp activity and feed consumption.

Why behaviour matters: Attractants, repellents, and real-world feeding

Shrimp feeding behaviour is nuanced. An ingredient may attract shrimp quickly but fail to sustain feeding. Others may be palatable but slow to draw shrimp to the feeding area.

This distinction is critical for additives such as attractants (amino acids, hydrolysates, top-coated additives) and repellents (certain antibiotics or functional compounds). There are also effects of processing such as pellet coating, inclusion amounts and leaching.

Le Reste highlighted a practical example of antibiotics and additives used in trout and shrimp feeds.

"Fish farmers top-coat antibiotics and sometimes, to increase efficiency, they use high amounts such that the feed becomes unpalatable. However, there is a major health and safety issue involved in adhering to the prescribed doses. The coating plays a central role here. In shrimp feeds, if top-coating of the additive is uneven, shrimp receive inconsistent doses. In our centre, we worked on top-coating of feeds and with our system, we can see how the coating method affects attractability and palatability."

Therefore, with the AI platform, the team at Halieutica can advise additive producers on:

- Whether their product is a repellent or an attractant
- Whether it should be included in the pellet or top-coated
- How processing affects functionality
- How to optimise dosage and application

This objectivity replaces the old method of "your eyes versus my eyes," where two observers watching the same aquarium could reach different conclusions.

Digestibility: bringing science to local ingredients

A strength at Halieutica are digestibility trials—an essential step for ingredient evaluation. While fish digestibility trials are outsourced to partners like INRAE or Sparos, shrimp digestibility is performed in-house using methods adapted to standard tanks.

One notable project involved cowpea, a drought-resistant legume widely available in sub-Saharan Africa. Working with INRAE and local partners in Congo, Halieutica collected cowpea samples, produced small experimental feed batches with digestibility markers and conducted digestibility trials at an INRAE research facility. It then published results at French and Ugandan aquaculture research events.

"With feed formulation software, such as Allix3 and Bestmix, we incorporate local ingredients such as cowpea for fish feeds in Africa. The findings help African feed mills evaluate locally available raw materials—critical in regions where supply chains are fragile and imported ingredients are expensive. In Congo, the main advantage of an ingredient is availability. The only other local supplies of aquafeed ingredients from industrial plants are wheat bran from wheat milling and beer byproducts."

A growing footprint in Africa and beyond

Halieutica's expertise extends far beyond France. The team works extensively across Africa, supporting private feed millers and development agencies such as the World Bank, Food and Agriculture Organisation of the United Nations (FAO) and Gesellschaft für Technische Zusammenarbeit (GTZ) and working on feeds for seabass, seabream and tilapia (Morocco and Egypt) and tilapia and catfish (Congo, Ivory Coast and Rwanda). From Morocco's emerging aquafeed factories to Egypt's poultry feed mills diversifying into aquaculture, Halieutica helps local players navigate the complexities of fish and shrimp nutrition. Their work included additive and ingredient evaluations, helping feed mills upgrade formulations, extruder operation training, on-farm troubleshooting, and technical workshops for distributors and feed producers to support smallholder aquaculture.

A clear strategy: Do one thing exceptionally well

Despite growing demand, Le Reste is firm about Halieutica's identity.

"We are not a startup so we don't burn cash. We are a classical business. We don't want to do everything. We want to do one thing—shrimp—and do it the best we can."

This focus has earned Halieutica strong relationships across the industry, including with competitors. By specialising in shrimp, they avoid overlapping with established fish research centres and maintain a unique position in Europe.

"We help companies already successfully marketing their feed additives into livestock production, bring these products into aquaculture with clear data on efficacy in fish and shrimp farming."

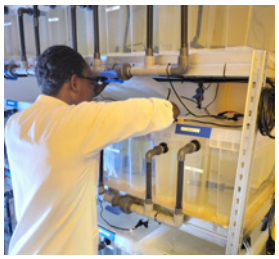
The road ahead

With six months of AI behaviour data already accumulated, Halieutica is now refining methodologies, expanding datasets, and exploring ways to standardise behavioural KPIs for the industry.

The goal is clear: to bring objectivity, repeatability, and scientific rigour to shrimp feed evaluation.

As Le Reste puts it: "We want to impose a standard that is no longer subjective. With AI, we can."

This specialised research hub in Angers is influencing feed strategies across continents. Halieutica's journey reflects resilience, innovation, and a deep commitment to advancing shrimp nutrition science.



Clockwise from top left. Moustapha Salamy, responsible for water quality assessment during the trials using in-house designed RAS; top coating feeds for trials with trout and view of aquariums for shrimp feeding behavioural analysis.

Appointments

Strategic hires in Southeast Asia

Aker QRILL Company, a global leader in krill-based functional feed ingredients has expanded its South east Asia team, with the appointment of two aquaculture professionals.

"Southeast Asia's aquaculture sector is not just growing – it is professionalising at a remarkable pace. Having Daranee and Yen on the ground means we can work shoulder-to-shoulder with feed mills and farmers, helping them formulate for performance and resilience. This is the right team at the right time to bring our science backed solutions closer to where they matter most," said Chaiyot Rawekchom, Regional Sales Director for Southeast Asia and General Manager Thailand.

Since 1 January 2026, Daranee is QRILL Product Director Shrimp in a global role, bringing over 16 years of experience in aquaculture nutrition and feed formulation. With a PhD in nutrition and deep expertise in the shrimp sector, Daranee will drive product strategy and technical conceptualization globally. She will focus on translating scientific documentation into commercial value, helping partners optimize feed formulations to improve performance and reduce costs.

Daranee Seguin, PhD., is QRILL Product Director Shrimp.

Yen Nguyen is Country Manager Vietnam.

Yen Nguyen joined as Country Manager for Vietnam, bringing six years of hands-on experience as an aquaculture nutritionist working with leading feed mills in Vietnam's market. She holds a degree in aquaculture from Can Tho University and a Master's degree from National Taiwan Ocean University. Her formulation expertise and deep understanding of local market dynamics make her ideally positioned to drive demand and support customers across Vietnam's fast expanding aquaculture sector.

General Manager for Thailand, Myanmar and Laos

Alltech, a global leader in animal nutrition and health, has appointed Chew Boon Kee (BK Chew) as general manager for Thailand, Myanmar and Laos and as APAC key account director. In this role, he will lead business strategy and operations across the three markets, supporting Alltech's continued growth in Southeast Asia. Chew will join established Alltech Southeast Asia leaders Dennis Garcia, covering the Philippines, Vietnam and Cambodia, and Heng Aik Jin, covering Malaysia, Singapore and Indonesia.

Prior to joining Alltech, Chew held senior leadership roles at several leading global agri-business and animal nutrition companies. He has worked with producers across the poultry, pork, aquaculture and ruminant sectors, developing customized nutrition programs to improve performance, enhance animal health and reduce reliance on antibiotic growth promoters. His expertise includes phytogenics, probiotics and bioactive feed additives, with a focus on sustainability.

He holds a bachelor's degree in animal science from Purdue University and completed graduate studies in reproductive physiology and endocrinology at the University of Idaho.

Chew Boon Kee (BK Chew) is General Manager for Thailand, Myanmar and Laos and APAC Key Account Director.

"BK Chew's appointment further strengthens Alltech's leadership team in Southeast Asia," said Kei Nakayama, managing director for Alltech Northeast and Southeast Asia. "His leadership will further strengthen our strategic partnership with key customers and advance our commercial strategy throughout Asia.

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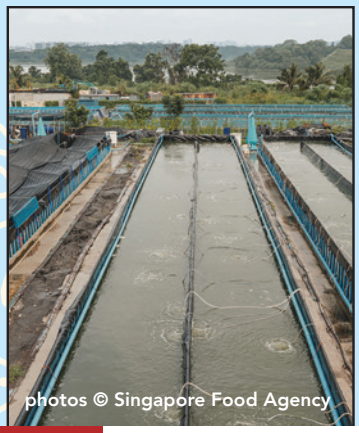

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World Aquaculture 2025 India: Demonstrating strength of Indian aquaculture

Shrinibas Mohanty, DGM at Avanti Feeds Ltd (middle) with some of his team members at WA 2025.

When the World Aquaculture Society (WAS) announced that the 2025 edition of World Aquaculture will be in India, it highlighted that aquaculture in Asia—especially India—is expanding rapidly, making 2025 "the perfect time" to bring the global community back to India. The last event was Asian Pacific Aquaculture 2019 in Chennai, Tamil Nadu. Furthermore, India is no longer just a participant but a driver of global aquaculture growth. By hosting this conference and trade show, aquaculture stakeholders reinforced India's position as a global aquaculture leader.

World Aquaculture 2025 India (WA 2025) was organised by the WAS–Asian Pacific Chapter (WAS-APC) with the support of the Government of Telangana and the National Organising Committee, comprising the Indian Council of Agricultural Research (ICAR) and the National Fisheries Development Board (NFDB). The event also received strong support from P.V. Narsimha Rao Telangana Veterinary University (PVNRTVU), the Society of Aquaculture Professionals (SAP), and the Marine Products Export Development Authority (MPEDA).

WA 2025 brought together over 3,600 participants from 63 countries, including 90 students. The international trade show featured 110 booths, with the active participation of local companies. The scientific conference had 438 abstracts, 298 oral presentations, 76 posters, and 45 technical sessions, reflecting the sector's growing research and development momentum.

At the opening, Dr Modadugu Vijay Gupta, World Food Prize Laureate (2005), presented on "Indian Aquaculture: Meeting Food and Livelihood Security," while Dr Manuel Barange, Assistant Director General, FAO discussed "Trends and Projections in Global and Regional Aquaculture: A Blue Transformation".

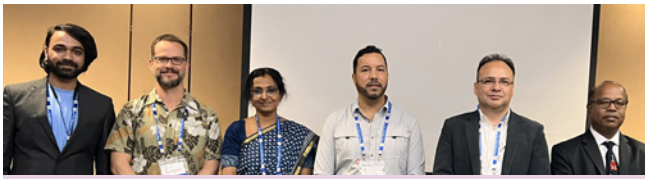
Professor A. Sarat Chandra, Registrar of PVNRTVU noted that Telangana, where Hyderabad is located, is a leader in inland aquaculture with fish production at 456,000 tonnes and shrimp production at 16,000 tonnes in 2023-2024. India is the second largest aquaculture producer with 19.5 million tonnes in 2024-2025.

Industry activities included a special farmer-focused session, organised by NFDB which brought together farmers from across India. MPEDA led its own multi-day parallel program, chairing export-focused sessions, and showcasing India's strategy for strengthening aquaculture exports. Its technical arm, RGCA-Rajiv Gandhi Centre for Aquaculture is the country's most important government-run aquaculture R&D and broodstock development organisation. A session highlighted RGCA programs (seabass, mud crab and the revival of the black tiger). SAP organised a four-hour breakout session "A bird's eye view of the Indian shrimp aquaculture sector".

From left, Drs Wendy Sealy, President World Aquaculture Society; J.K. Jenaj, Deputy Director General (Fisheries Science), ICAR and conference chair; and Bibha Kumari, President, World Aquaculture Society, Asian Pacific Chapter.

Kumaresan, Senior DGM and Pan India Technical Head, at Sheng Long Biotech India (right) with Authinathan, India.

From right, Malaysian exhibitor Yoke Fah Yew, Speedy Assay Sdn Bhd, with Karunanithi, Yogaa Bio Shrimp, Malaysia and B.G. Das, Advance Aqua Bio Tech, India.



Speakers in the session on Aquaponics and other Systems with chairs, Dr Bikash C Mohapatra (right) and Professor Devika Pillai, ICAR (Fisheries Science, third left).

The Adisseo team with aquaculture producers and feed manufacturers at the technical forum during WA 2025.

Adisseo showcases aquaculture innovation and sustainability solutions

Adisseo is advancing its position as a key contributor to sustainable aquafeed development. During a technical forum with producers and feed manufacturers, the company's specialists presented recent advances in aquaculture nutrition, innovation, and sustainability practices.

Dr Peter Coutteau, Global Director of Aquaculture at Adisseo, led the APAC team in delivering insights into the company's aquaculture solutions. Dr Ei Lin Ooi, Regional Manager for Aquaculture APAC, introduced FeedKind, a novel functional microbial ingredient derived from natural gas fermentation. Research has demonstrated FeedKind's efficacy as a nutritious protein source, while supporting immunity and modulating gut health to enhancing disease resistance, for example in shrimp against acute hepatopancreatic necrosis disease (AHPND). FeedKind has also been demonstrated to improve pellet quality and feed processing costs. Compared to traditional protein sources, its production process requires no arable land, is water-efficient and climate-proof, thus offering significant sustainability advantages.

Addressing economic pressures in shrimp production

Martin Guerin, Regional Technical Manager for Aquaculture APAC/ISC, addressed the economic challenges facing shrimp producers, particularly in India where production costs remain substantially higher than in competing countries, such as Ecuador. Within this context of optimising production efficiency, Martin detailed the application of lysophospholipids in feed formulation. Adisseo's Aqualyso is a lysophospholipid-based metabolic and digestibility enhancer manufactured through controlled enzymatic hydrolysis of vegetable lecithins. The process selectively cleaves one fatty acid from the phospholipid molecule, converting standard phospholipids into highly bioactive lysophospholipids (LPLs). Applications of Aqualyso have consistently improved animal performance while optimising feed costs. Guerin also introduced Pepsea, Adisseo's new palatability enhancer enriched with free amino acids, designed to improve feed intake and performance in reduced-fishmeal formulations.

Comparative analysis of shrimp feed formulations demonstrated the impact of bile salt supplementation in low-fishmeal diets. Trial data showed that bile salts can be incorporated into low-fishmeal diets with reduced fish oil and lecithin while maintaining growth performance. Martin also examined the potential effects of bile salts on shrimp health. He emphasised that proper dosage is critical, as excessive bile salt concentrations can damage intestinal epithelial tissue. Additionally, excessive use of bile salts may disrupt microbiota composition and destabilise the gut ecosystem—a significant concern given the shrimp's substantial dependence on gut microbiota for digestive function. Peter cautioned that while some commercial products contain very high bile salt concentrations, such formulations present dual risks: potential harm to shrimp health and occupational safety concerns for farm personnel handling concentrated bile salt products. This underscores the importance of scientifically validated dosing protocols in product development and application.

Adisseo's technical presentations demonstrated the company's integrated approach to aquaculture nutrition, combining sustainable ingredient innovation with practical formulation strategies that address both economic viability and animal health outcomes in commercial aquaculture operations.

Feeds, feed additives and services

Most exhibitors were in this group, comprising multinational and home-grown companies. **Avanti Feeds Limited** (AVANTIFEED) is listed on India's NSE. Avanti operates primarily in aquaculture, with its core businesses centred on shrimp feed manufacturing and shrimp processing for export. The company is one of India's largest players in this sector, supported by vertically integrated operations and a strong nationwide farmer network. It is a leader in India's shrimp feed business, with more than 50% market share in 2025, according to industry. It has a joint venture with Thai Union Frozen Products PCL for its feed and seafood business and with Thai Union Hatcheries for its state-of-the-art hatchery in Visakhapatnam in Andhra Pradesh. It has six feed plants for fish and shrimp nationwide, five in Andhra Pradesh and one in Gujarat.

Devee Nutri International, based in Hyderabad, supplies feed and health-support additives specifically for livestock and aquaculture. The company offers a variety of solutions focused on improving shrimp and fish health, tackling disease management, and supporting environmental sustainability. At this event, they introduced K19, an innovative alternative to antibiotics that enhances growth, blood health, antioxidant activity, immune response, and resistance to harmful bacteria in aquaculture.

ADM Vietnam has introduced new probiotic products aimed at supporting aquatic health. As a central player in Archer Daniels Midland's Asia-Pacific supply chain, ADM Vietnam is involved in areas such as complete animal feed, premixes, aquaculture nutrition, food and beverage ingredients, and agricultural commodity supply. One of their products, BactoSafe contains a concentrated blend of beneficial live bacteria to enhance water quality and promote the health of fish and shrimp in ponds. This product is for hatcheries and grow-out systems to stabilise pond microbiology and minimise harmful substances.

Saji Chacko, President of SAP (middle) with moderator, S. Santhana Krishnan (fifth from right), speaker A.V. Suresh (fourth from right), some members of the executive committee and visitors.

Bird's Eye View of the Indian Shrimp Aquaculture Sector

On 12 November 2025, SAP conducted a four-hour breakout session, moderated by S. Santhana Krishnan, Founder President of SAP. The session featured six presenters, all of them have played a significant role in propelling India's shrimp aquaculture sector to its current global standing. It was a comprehensive overview of India's shrimp aquaculture, discussing challenges in hatchery operations, shrimp nutrition, innovative farming practices and domestic marketing.

Saji Chacko, President of SAP, began with an overview of production and market trends. According to SAP's 2024 review, India produced 930,000 tonnes of shrimp, marking a 9% increase. Out of this total output, vannamei shrimp accounted for 875,000 tonnes, with Andhra Pradesh being responsible for 73% of the production. The most significant growth occurred in the new western and northern regions, where output increased by 10–15%. Feed costs rose by 10% after COVID-19, further adding to the production pressures faced by farmers. Farmgate prices in 2025 were unpredictable. They remained slightly above 2024 levels.

India is the second-largest shrimp exporter after Ecuador. In August, a 58.26% US tariff led to a 43% decline in Indian shrimp exports to the US; however, shipments to China rose 33% and to the EU 58% (Shrimp Insights, 2025). By September, exports to China increased by 46%, highlighting the exporters' ability to pivot.

SPF broodstock has boosted monodon shrimp production, with MPEDA reporting 65,000 tonnes in 2025. Over 80% of Gujarat now farms monodon shrimp. Saji expects monodon to stabilise output, as farmers facing issues with vannamei shrimp farming switch. Notably, the prices of this shrimp have remained high.

According to SAP, production is projected to reach a record one million tonnes in 2025. MPEDA reported that value-added products comprise 16% of exports in 2025. Growth in cooked, breaded products was 27%. Moving forward, SAP's vision is for domestic consumption to be at least 30% of annual production by 2030. The reliance on a single species should be reduced by developing SPF broodstock of local species, *Penaeus indicus* and *Penaeus merguiensis*.

Hatcheries: Essential for production

D. Ramraj, Past President of SAP, traced the evolution of India's shrimp hatchery sector from the 1970s to today. From 1975 to 1985, shrimp larval rearing and controlled spawning were achieved for several species, including *Penaeus indicus* and *P. dobsoni*. Five generations of domesticated *P. indicus* were produced, demonstrating strong growth potential and suitability for Asian aquaculture. As demand surged for *P. monodon* post larvae (PL) in India, MPEDA worked on scaling up production. The turning point for the segment was two landmark hatcheries—TASPARC in Andhra Pradesh and OSPARC in Odisha. In the 1990s, over 200 hatcheries were producing 5–6 billion PL annually. In 1994, white spot syndrome (WSSV) outbreaks led to PCR screening and stricter biosecurity controls.

In 2009, with the introduction of SPF *P. vannamei*, hatchery capacity expanded to over 550 units, producing 150 billion PL annually. Government licensing through CAA, centralised quarantine, and strict broodstock import protocols strengthened biosecurity and traceability. Today, India's shrimp hatchery sector remains one of the world's largest and most regulated, shaped by decades of scientific, technological, and policy milestones.

Recalibrate

In "Reset. Rethink. Reposition: Steering India's shrimp industry through trade and disease challenges," Ravi Kumar Yellanki, Past President of SAP, presented the following observations:

Reset is to acknowledge the new global reality. India now faces disease-driven farm instability, reduced competitiveness versus Ecuador, and trade barriers. The US has imposed new tariffs and import regulations, while the EU will apply Regulation 2024/2598 from September 2026. Animal welfare rules may also impact farming methods. The old model of high volume vannamei exports to the US is no longer reliable.

Uddaraju Dushyant Kumar, Managing Partner at Devee Nutri International (centre right) and Dhanunjaya Goud, Group Director – Sales - Domestic & International (second right).

Rethink farming by focusing on essentials such as biosecurity, lower stocking densities, nurseries, crop breaks, rotation, and species diversification—particularly *P. monodon* and reverse-SPF lines—to mitigate disease pressure. Strengthen compliance with traceability, residue free, and animal welfare requirements, while shifting towards value added processing and premium segments.

Repositioning involves shifting strategy to build a domestic market by capitalising on rising incomes, retail/e-commerce growth, and increasing protein demand, similar to approaches in China and Brazil. Globally, India's repositioning focuses on innovation, resilient farming, species diversification, and robust farmer-processor networks for sustained competitiveness beyond commodity shrimp.

Solutions for the domestic market

For Aditya Dash, Managing Director of Ram's Assorted Cold Storage, processing is not just machinery, but the entire journey from pond to pallet. Processors are challenged by rising transport costs, worsening farm economics, new US tariffs, non-tariff and labelling issues, de facto regulations and the influence of BAP/ASC standards.

After 20 years of building an export-focused segment for the US and EU, Indian processors find it difficult to enter the Asian markets where consumers demand true freshness and colour. Transport costs are a major hurdle for delivery in the domestic market which prefers fresh shrimp. A solution is to create a dedicated cold-chain freight corridor with re-icing stops, from Vijayawada to Hyderabad and then to Delhi, NCR. Other solutions are adopting models like Odisha's Chilika Fresh, where the state provides kiosks and freezers for seafood retail points. Branding remains important, but it competes with infrastructure for government funding. During the panel discussion, he recommended focusing on minimal processing options tailored for the domestic market and enlisting the participation of small and medium-sized processors, while major processors focus on the export market.

Shrimp nutrition and feeds

In his discussion on shrimp nutrition, A.V. Suresh, Past President of SAP, noted that farms with 80% success combined good feeding with effective biosecurity and disease management, while struggling farms generally lacked strong disease control despite good feeding practices.

On feed optimisation, Suresh cautions against focusing only on feed price/kg. What matters is the cost of feed per kilogram of shrimp produced. Other needs are matching feed type to stocking density and farm environment. As breeding programs evolve, farmers must adapt feed choices to the genetic potential of their shrimp. Feed, nutrition, and health are interconnected. The right feed can support disease prevention, enhance immunity, and improve resilience. However, while there are studies on nutrients and ingredients, the industry still lacks a good understanding of how they work in real world farm conditions. There are opportunities to create functional feeds with additives such as immunostimulants, organic acids and nucleotides or higher supplementation of vitamins, etc., for targeted use at specific times.

India's farming conditions vary widely, and there is a long held assumption that one diet can suit all farms. Companies like Growel Feeds are now offering multiple diets with varying crude protein levels. Trials show that at low stocking densities, lower protein diets can deliver similar performance at significantly lower cost. He concluded that farmers must choose feeds strategically. Selecting the right diet and applying the right feeding strategy leads to better economics—not just lower feed prices.

Sustainable and resilient

Year-on-year, shrimp prices are coming down. To continue producing, the cost of production should be commensurately lower, said Srinivasa Rao Patchala, Senior Technical Manager, Avanti Feeds Ltd. He made this point while discussing sustainable and resilient shrimp farming practices in India. Some 60% of production came from small and marginal farmers who have invested their livelihood in shrimp farming. Disease remains a major constraint. With threats such as *Enterocytozoon hepatopenaei* (EHP), white faeces syndrome (WFS), WSSV and running mortality syndrome (RMS), strengthening biosecurity and early detection remains essential for long term resilience.

Generally, farmers select shrimp genetic lines based on local history and pond records, hardy or balance lines for low- or high-salinity farming and faster growth lines for disease-free or clean environments. Cluster farming is everywhere in India. Srinivasa Rao cited how a cluster of 2,000 farmers works together to schedule crop breaks and thoroughly dry ponds over 2 months during the summer period. Harvests improved to 7-8 tonnes/ha. Another model is ecological farming of vannamei shrimp with paddy in low-saline areas.

Probiotics are a pillar of sustainable farming, and today, there is a high reliance on *Bacillus* and *Lactobacillus based* probiotics to maintain pond health. A more frequent application of the dosage (0.3%) is recommended during the initial stages of culture. Feed efficiency remains central to a profitable and sustainable business. He emphasised the importance of monitoring feed colour, tracking cumulative weekly feed, and maintaining accurate biomass estimates.

The Lallemand team (from right), Jayashankar Thanna, Vincent Couture and Stephane Ralite, with Olivier Decamp, Inve Aquaculture (left).

Session Chairs for Alternative Feed Ingredients and Feed Technology, Professor NP Sahoo, ICAR-CIFE, and Ronnie Tan, USGBC, Malaysia, with Dr Manoj Sharma, Mayank Aquaculture (middle).

2026

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aquaprofessional.org

February 2-6
35th Annual Practical Short Course on Feeds, Petfood and Aqua Extrusion
Texas A&M University, USA
teesedge@tamu.edu

February 5-6
International Workshop on Aqua Nutrition (IWAN 2026)
Chennai, India
iwan.tnjfu.ac.in

February 12
Shrimp Outlook 2026
Jogjakarta, Indonesia
jala.tech/outlook

February 16-19
Aquaculture America 2026
Las Vegas
was.org

March 10-12
VIV Health & Nutrition Asia/ Victam Asia 2026
Bangkok
vivhealthandnutrition.nl/

March 18-20
VietShrimp Asia 2026
Ho Chi Minh City
vietshrimp.vn

May 18-21
The International Symposium on Fish Nutrition and Feeding (ISFNF 2026)
Darwin, Australia
agentur.eventsair.com/isfnf2026/

June 2-5
World Aquaculture Singapore 2026
was.org

August 19-20
TARS 2026: Aquafeeds
Bali, Indonesia
tarsaquaculture.com

TARS 2026
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September 1-3
Global Shrimp Forum
Utrecht, The Netherlands
shrimp-forum.com

VIV HEALTH & NUTRITION ASIA

Visitor Registration is open for VIV Health & Nutrition Asia 2026

VIV Health & Nutrition Asia, in co-location with VICTAM Asia has officially opened visitor registration for its 2026 edition. The event will take place from 10–12 March 2026 at Bangkok International Trade & Exhibition Centre (BITEC) in the vibrant heart of Bangkok, Thailand.

VIV Health & Nutrition Asia is the region's essential platform for professionals focused on innovation in nutrition, pharmaceuticals, and high-tech animal health solutions. This edition will bring together industry leaders, innovators, and stakeholders from across Asia and beyond for three intensive days of business networking, cutting-edge technology showcases, and knowledge exchange across the entire animal feed and health value chain.

A world-class platform for animal feed and health professionals

From feed ingredients and additives to pharmaceuticals, genetics, veterinary technology, and health solutions, VIV Health & Nutrition Asia 2026 will explore the complete spectrum of animal nutrition and health innovation. Combined with VICTAM Asia's expertise in feed and crop processing technology, this co-located event offers unparalleled coverage of both feed manufacturing technology nutrition, and health under one roof.

The exhibition floor will feature over 300 global and regional exhibitors, presenting immersive product displays and live demonstrations of state-of-the-art solutions in feed production technology, nutritional innovations, pharmaceutical developments, and veterinary advancements. With over 9,000 expected professional visitors from across Asia and a comprehensive conference program, the event is the perfect opportunity for industry professionals to discover new suppliers, innovative solutions, and strategic partnerships.

The three-day conference program will cover poultry, swine, aquaculture, and dairy sectors. It will tackle Asia's most pressing challenges through sessions on building resilient feed systems, disease prevention and antibiotic reduction, and policy frameworks for sustainable animal production.

Two proven events, one powerful experience

The co-location of VIV Health & Nutrition Asia with VICTAM Asia creates a unique synergy: VIV's extensive worldwide network in animal health and nutrition combined with VICTAM's position as the world's largest dedicated event for the animal feed processing industry. Together, these shows attract a diverse professional audience including feed formulators and mill managers, animal nutritionists and veterinarians, CEOs and operations directors, animal feed compounders, aquafeed producers, integrators, health solution providers, and pharmaceutical specialists.

Register here

https://shorturl.at/4SJXv

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