



Modeling future seafood demand onto marine ingredient demand

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Summary

Over the past two decades, aquaculture emerged as the primary driver of global seafood supply growth, yet this expansion did not result in a proportional increase in fish meal and fish oil demand. This reflected not weaker growth in fed aquaculture species, but rather a sustained decline in fish meal and fish oil inclusion rates in aquafeed, supported by improvements in feed conversion ratios and broader gains in formulation efficiency. Together, these developments enabled the industry to increase output without a corresponding increase in pressure on an already constrained supply of marine ingredients. The next decade is likely to present a more challenging backdrop. Across the US, Europe, and China, both seafood demand and aquaculture production are tilting toward species with more exacting nutritional needs. In western markets, consumption growth is becoming more concentrated in premium farmed species such as salmon and shrimp, while in China, marine finfish are assuming a larger role in aquaculture expansion.

Holding current inclusion rates constant, our baseline analysis indicates that changing seafood demand across the three markets could generate approximately 900,000 metric tons of additional fish meal demand and 130,000 metric tons of additional fish oil demand by 2035. While not a forecast of actual use, the results highlight the challenge of accommodating growth within a constrained and increasingly uncertain supply base. The outcome will depend on the pace of feed innovation, ingredient substitution, and efficiency gains, particularly in China. If these advances fail to keep pace with production growth, stronger competition for marine ingredients and greater exposure to climate-related disruptions could increase price pressure and volatility while accelerating investment in alternative ingredients and diversification of ingredient types.

Seafood demand shifts toward species with higher marine ingredient requirements

Aquaculture has become the world's most important source of seafood growth and much of this expansion was feasible due to improved feed formulations. As highlighted in [our report](#), a combination of reduced inclusion rates, precision feeding, and improvements in feed efficiency allowed the industry to achieve that expansion without placing equivalent strain on the markets for fish meal and fish oil.

This dynamic is unfolding alongside a broader change in demand composition, as growth in major markets – the US, EU and China – is increasingly driven by species that remain more dependent on marine ingredients for essential nutrients, most notably salmon, shrimp, and marine finfish. While the underlying drivers differ across regions – ranging from consumer preference and substitution dynamics to production expansion – a common pattern is emerging: Seafood demand is becoming structurally more fish meal- and fish oil-intensive.

Modeling approach and baseline assumptions

This analysis is intended as a demand-estimation exercise rather than a forecast of future feed formulations. While fish meal and fish oil inclusion rates have declined over time and will continue to evolve as technology, ingredient availability, and feed economics change, the baseline scenario holds current species-specific inclusion rates constant to isolate the effect of seafood demand growth on marine ingredient requirements.

Seafood consumption is first projected across the US, Europe, and China using region-specific demand drivers, including income growth, changing consumer preferences, substitution away from wild-caught species, and the expanding role of aquaculture. Demand is then allocated across three species categories: high, medium, and low marine ingredient intensity, based on the relative importance of fish meal and fish oil in feed formulations.

Current feed formulations and inclusion rates are subsequently applied to translate projected seafood demand into estimates of fish meal and fish oil requirements. The exercise is not intended to predict future formulation practices. Rather, it illustrates the scale of marine ingredient demand implied by current consumption trends and highlights the extent to which innovation, alternative ingredients, improved feed efficiency, or shifts in species consumption may be required to balance future supply and demand.

US: Growing appetite for salmon and shrimp lifts marine ingredient demand

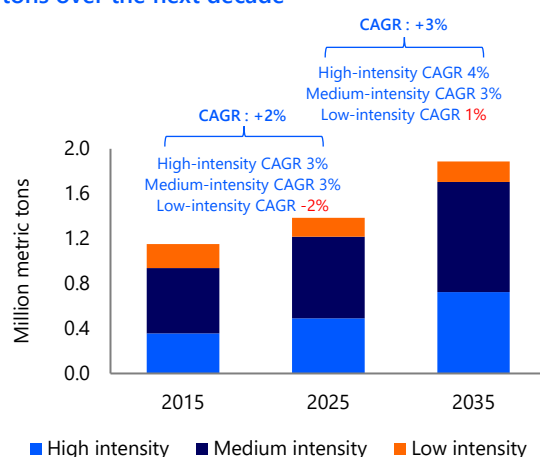
Under the baseline scenario, US consumption-driven demand for marine ingredients continues to increase over the coming decade. Assuming no material changes in marine ingredient intensity, fish meal demand is projected to rise by roughly 50,000 metric tons and fish oil demand by approximately 30,000 metric tons, equivalent to compound annual growth rates of around 3% and 4%, respectively (see figure 2). These figures should be viewed as an illustration of the marine ingredient demand associated with future seafood consumption growth rather than a forecast of actual fish meal and fish oil use.

The outlook is underpinned by resilient demand for farmed seafood, particularly salmon and shrimp, which have been the primary drivers of growth within an increasingly concentrated US seafood market, where the top ten species account for roughly 75% to 80% of consumption. Supported by rising incomes, strong consumer acceptance, [growing demand for lean protein and omega-3-rich foods](#), and the relative competitiveness of seafood against high-priced beef, these trends are expected to persist. As a result, growth is concentrated in species groups with higher marine ingredient requirements. Salmon represents much of the high marine ingredient intensity category, while shrimp accounts for a significant share of the medium-intensity category. Under the baseline scenario, consumption of the high-intensity group is projected to grow at approximately 4% compound annual growth rate (CAGR) over the next decade, with the medium-intensity group expanding at around 3% CAGR, (see figure 1) making these categories the principal contributors to projected growth in fish meal and fish oil demand.

However, historical evidence suggests that this relationship is unlikely to be linear. Despite strong growth in US consumption of salmon and shrimp over the past decade, fish meal and fish oil demand did not increase at the same pace. As two of the world's most industrialized aquaculture sectors, salmon and shrimp have benefited from decades of investment in feed technology, farming efficiency, and ingredient optimization, enabling production growth while reducing the marine ingredient intensity of output. The baseline scenario presented here does not attempt to capture future improvements of this kind. Rather, it assumes that current marine ingredient intensity remains unchanged to illustrate the scale of demand implied by continued growth in premium farmed seafood consumption. In practice, salmon and shrimp remain among the species best positioned to deliver further gains in feed efficiency and ingredient substitution. As a result, the projected increase in fish meal and fish oil demand is best viewed as a demand benchmark

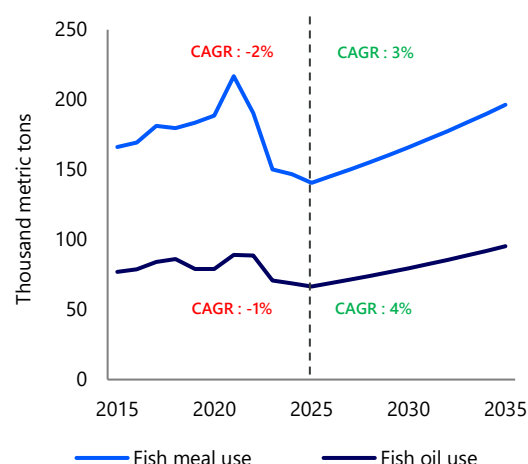
rather than a forecast, highlighting the scale of innovation, adoption of alternatives, and productivity gains that may be required to accommodate future consumption growth.

Figure 1: US demand for fishmeal- and fish oil-intensive species to rise by around 500,000 metric tons over the next decade



Source: FAO, Trade Data Monitor, RaboResearch 2026

Figure 2: US fish meal and fish oil use expected to rise by around 40% over the next decade



Source: IFFO, FAO, RaboResearch 2026

EU: Feed efficiency gains temper rising demand for marine ingredients as farmed seafood replaces wild catch

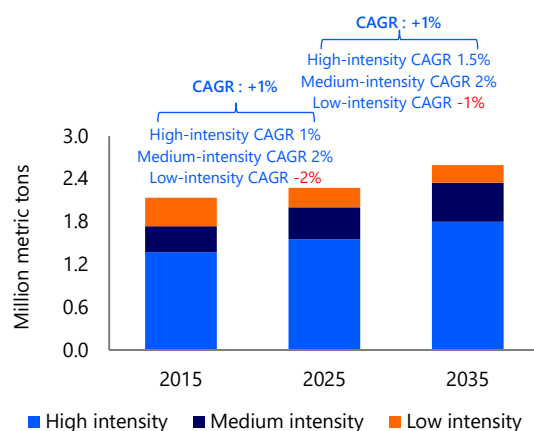
Applying the same modelling framework as in the US analysis, while reflecting Europe's distinct market dynamics, the results point to a modest increase in marine ingredient demand over the coming decade. Under our illustrative baseline scenario of unchanged marine ingredient intensity, fish meal demand is projected to rise by approximately 40,000 metric tons and fish oil demand by around 25,000 metric tons, equivalent to growth of roughly 2% CAGR for both products (see figure 4).

The underlying trend is a continued reallocation of seafood demand. Declining regional self-sufficiency, reduced wild-capture availability, and tighter fisheries management have steadily shifted consumption toward farmed species. Salmon has been the clear beneficiary of this transition. Supported by year-round availability, strong retail penetration, and a well-established health and nutrition proposition, salmon has accounted for much of the growth in the EU seafood basket over the past decade and is likely to remain the dominant driver of future demand (see figure 3). This has important implications for marine ingredients as the high-intensity category is largely comprised of salmon and therefore represents the principal source of projected fish meal and fish oil demand growth within the model. As consumers continue to substitute farmed seafood for wild-caught alternatives, the share of seafood consumption in EU associated with higher marine ingredient intensity species is likely to increase.

Despite salmon's increasing prominence within the European seafood basket, both fish meal and fish oil use have declined over the past decade, reflecting the sector's long record of innovation in feed formulation, nutrition, and production efficiency. Further advances in feed technology and ingredient utilization are likely to continue moderating the relationship between salmon consumption growth and marine ingredient demand. As a result, the more significant challenge for EU may not be how much fish oil the region requires, but how growing competition for a finite global supply influences its cost and availability. As Chinese aquaculture expands and demand for marine ingredients grows, competition for finite global supplies may increasingly shape market outcomes. For European salmon producers, the more significant consequence may emerge through pricing rather than supply constraints, as a growing number of aquaculture sectors compete for the same resource base. While feed innovation may continue moderating the sector's

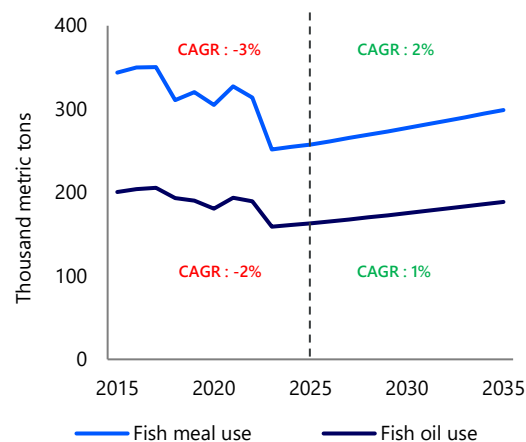
reliance on marine ingredients, growing global demand could increase the strategic importance of marine ingredients and their influence on feed economics over the coming decade.

Figure 3: Salmon is expected to remain the key driver of high-value aquaculture consumption growth in the EU



Source: EUMOFA, RaboResearch 2026

Figure 4: EU changing seafood mix could increase fish meal and fish oil demand by around 2% annually



Source: IFFO,FAO RaboResearch 2026

China: Emerging as the main engine of marine ingredient demand

Applying the same modeling framework, under a baseline scenario of unchanged marine ingredient intensity, fish meal demand could rise by approximately 700,000 metric tons over the next decade, while fish oil demand could increase by around 80,000 metric tons (see figure 6). The scale of these figures underscores China's role as the principal volume driver in global marine ingredient markets.

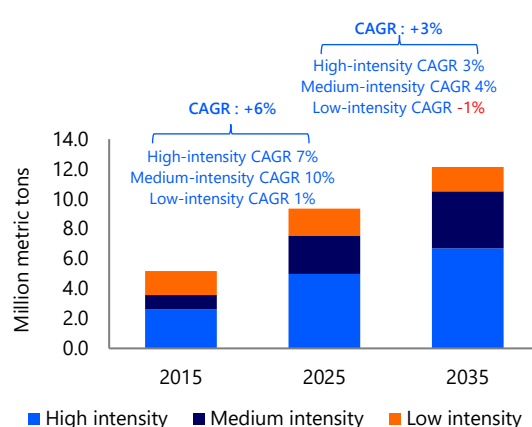
The key shift is not simply higher seafood consumption, but a [reconfiguration of China's aquaculture production](#) base to meet evolving demand. While low-value freshwater species such as carp continue to underpin Chinese seafood consumption due to their scale, affordability, and cultural significance, demand growth is increasingly concentrated in high- and medium-intensity fed aquaculture species, particularly carnivorous freshwater fish, shrimp, and marine finfish. This shift carries important implications for marine ingredient demand, as many of the species for which demand is growing rely more heavily on fish meal than the traditional freshwater species that have historically dominated production. As a result, much of the projected increase in fish meal demand is linked to the expansion of high- and mid-intensity carnivorous freshwater species such as largemouth bass and snakehead (see figure 5). Fish oil dynamics are more nuanced. Although many of China's expanding marine finfish species utilize lower fish oil inclusion rates than salmon, the scale of production growth means that even relatively modest inclusion levels translate into meaningful additional demand. This creates a different challenge from that seen in Europe or the US. Salmon and vannamei shrimp have benefited from decades of feed innovation, industrialized production systems, and continuous improvements in ingredient utilization. Many of China's fastest-growing species appear to be at an earlier stage of that development curve. Production has expanded rapidly, but formulation capability has not always advanced at the same pace.

Against this backdrop, two broad scenarios emerge. In the first, China remains the primary volume driver of fish meal and fish oil demand in the near term, while advances in feed formulation, ingredient substitution, and nutritional efficiency gradually reduce the marine ingredient intensity of its fastest-growing species. Under such an outcome, demand growth would remain substantial, but the long-term requirement for fish meal and fish oil would become progressively lower as producers improve feed formulations for emerging species.

The alternative is that production growth continues to outpace innovation. In this scenario, the expansion of carnivorous freshwater species and marine finfish could steadily shift the global demand curve for fish meal and fish oil higher, increasing competition for a relatively constrained supply base and placing upward pressure on prices. This could potentially bring China's aquaculture sector into more direct competition with highly industrialized aquaculture sectors such as the salmon sector, which also depend on marine ingredients. In a higher-price environment, species with elevated marine ingredient requirements may become increasingly challenging to produce competitively, particularly if gains in feed efficiency fail to keep pace with production growth. This could create opportunities for more mature and efficient aquaculture sectors, such as those producing Atlantic salmon and vannamei shrimp, to capture market share if Chinese producers struggle to remain cost competitive.

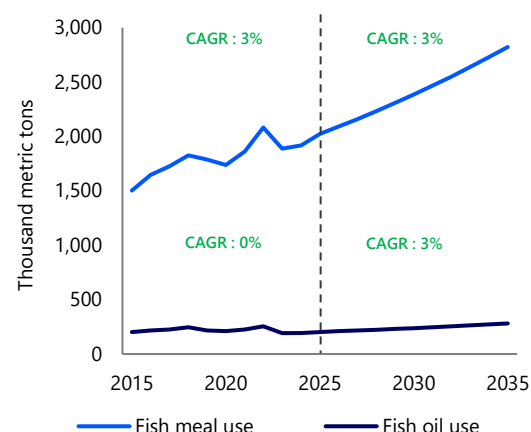
China therefore represents both the largest potential source of future marine ingredient demand and the industry's largest innovation opportunity. The extent to which its emerging aquaculture sectors can replicate the formulation and nutritional advances achieved in salmon and shrimp may prove one of the defining factors shaping global fish meal and fish oil markets over the coming decade.

Figure 5: China's changing seafood preferences favor further growth in high- and mid-intensity species



Source: IFFO, FAO, Trade Data Monitor, RaboResearch 2026

Figure 6: China's fish meal and fish oil demand could rise 40%, cementing its position as the largest buyer



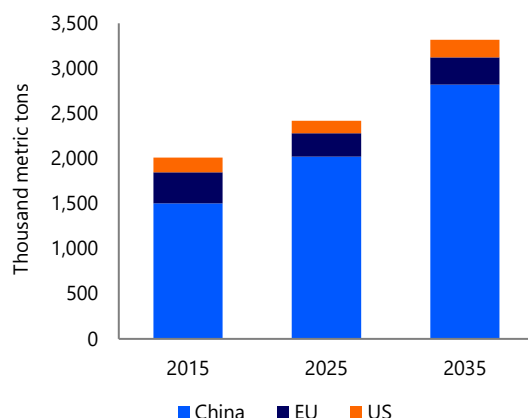
Source: IFFO, FAO, RaboResearch 2026

Changing seafood demand could add 900,000 metric tons of fish meal and 130,000 metric tons of fish oil demand by 2035

For much of the past two decades, aquaculture production expanded without placing equivalent pressure on fish meal and fish oil demand, as sustained innovation reduced the marine ingredient requirements to support growth in aquaculture production. That relationship may now be beginning to evolve. Across the US, Europe, and China, seafood demand growth is increasingly concentrated in species where fish meal and fish oil remain important nutritional inputs, raising the potential for stronger underlying demand for marine ingredients.

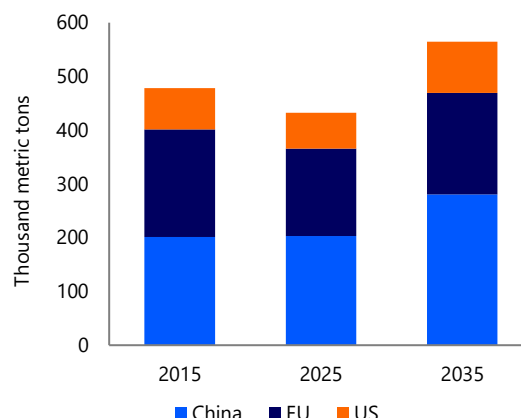
Under the baseline assumptions applied throughout this analysis, this shift in growth toward species with higher marine ingredient requirements would imply approximately 900,000 metric tons of additional fish meal demand (see figure 7) and 130,000 metric tons of additional fish oil demand (see figure 8) over the next decade. The baseline scenario is best understood as a measure of potential demand rather than a prediction of future outcomes. The extent to which that demand ultimately emerges will depend on the pace of innovation across aquaculture, feed formulation, and ingredient development. The defining challenge may not be producing enough seafood but doing so with progressively less dependence on finite marine resources.

Figure 7: Fish meal demand could rise by 900,000 metric tons by 2035



Source: RaboResearch 2026

Figure 8: Fish oil demand could rise by over 130,000 metric tons by 2035



Source: RaboResearch 2026

El Niño offers a glimpse of future scarcity

The demand outlook described in the previous chapter changes the context in which supply risk should be assessed. Under the baseline scenario, growth in seafood consumption translates into additional demand for fish meal and fish oil because species-specific inclusion rates are held constant. This assumption serves as an analytical benchmark rather than a prediction of future feeding practices. In reality, the aquafeed industry is likely to continue improving feed efficiency, lowering inclusion rates where possible, and increasing the use of alternative ingredients. Nevertheless, the scenario illustrates the scale of adaptation that may be required across the aquaculture and feed industries to support continued growth in seafood production.

In this context, disruptions in the supply of marine ingredients could have increasingly significant consequences if demand growth outpaces the industry's capacity to achieve further gains in efficiency and productivity. As demand increases and species composition shifts toward more marine-ingredient-dependent production systems, climate-related supply risks are likely to become increasingly important. The first is short-term volatility associated with El Niño events; the second is the longer-term effect of ocean warming on the environmental conditions in which those events occur. El Niño remains the most immediate concern. By disrupting Peru's Humboldt Current upwelling system, which supports nutrient availability in surface waters, it can alter anchoveta distribution and increase uncertainty around biomass development. The 2023 event illustrated this risk, contributing to the cancellation of Peru's first anchoveta fishing season in 2023 and a cautious approach to subsequent quota setting.

The challenge, however, is no longer simply one of distinguishing between an El Niño and a normal year. Recent El Niño-Southern Oscillation (ENSO) events have occurred against a backdrop of rising ocean temperatures, raising the possibility that ecological responses increasingly reflect the interaction between natural climate variability and longer-term warming trends. For anchoveta, the key issue is therefore not simply the classification of an ENSO event, but the ecosystem conditions that determine biomass, recruitment, and catchability.

The key implication is that structural demand growth and environmental volatility are increasingly moving in the same direction. In such a market, disruptions could have a greater impact on availability, inventories, and pricing as the capacity to absorb shocks gradually narrows.

Aquaculture's next growth phase hinges more than ever on feed innovation

The regional analysis also suggests that the challenge will not be evenly distributed. In the US and EU much of the projected growth is concentrated in species that have benefited from decades of advances in feed formulation, nutrition, and ingredient optimization. China presents a different challenge, as mentioned earlier in the report. As the largest contributor to potential demand growth, its expanding production of carnivorous freshwater fish and marine finfish is likely to exert a disproportionate influence on global fish meal and fish oil markets.

The central issue is therefore not only whether tighter marine ingredient markets will be balanced through higher prices or innovation, but whether innovation can scale quickly enough to keep pace with growing demand. In practice, the outcome is likely to involve both. Sustained price pressure may continue to signal scarcity and support investment in alternative ingredients, new nutrient sources, and supply-chain resilience.

However, the challenge lies less in identifying potential solutions than in accelerating investment, validation, and adoption throughout the value chain before marine ingredient availability becomes a more meaningful constraint on growth. Viewed through this lens, tighter fish meal and fish oil markets may not only create pricing pressure but also strengthen the economic case for diversification and innovation. The long-term opportunity may lie in broadening the range of viable nutritional solutions available to the industry, improving resilience while reducing exposure to supply concentration and environmental volatility. Higher prices may therefore prove to be more than a symptom of scarcity. They may become the catalyst that accelerates investment, innovation, and adoption of alternative ingredients across the value chain, reshaping the marine ingredient landscape long before physical supply becomes the binding constraint.

Imprint

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