CFI The Centre for Feed Innovation

Single-Cell Proteins

Executive Summary
2026 State of the Industry Report

Single-cell proteins are emerging as a credible and scalable alternative to fishmeal

Aquaculture growth depends on high-quality protein traditionally sourced from fishmeal. However, constrained global supply and rising demand are driving price volatility and pressure on pelagic fisheries. This report assesses the nutritional performance, scalability, sustainability, and safety of single-cell proteins (SCPs) as a fishmeal substitute in aquafeeds.

Comparable or improved nutritional performance

SCPs can deliver comparable or improved nutritional performance and replace a meaningful proportion of fishmeal, while maintaining feed quality.

Strong circularity potential

Bacteria and yeast-based SCPs can utilise industrial and biogenic waste streams to produce protein with potentially reduced environmental impacts.

Established safety frameworks and production systems

Microorganisms and fermentation have a long history of safe use in animal nutrition; novel SCPs can use these systems for faster and safer scale-up.

Approaching price parity with fishmeal

Some SCPs are priced competitively with fishmeal, however, scaling remains constrained by high capital intensity and sensitivity to input costs.

Positioned to diversify aquafeed protein inputs

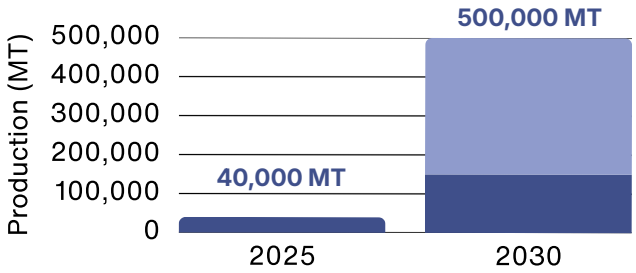
Although SCPs have experienced early commercial adoption, current inclusion rates remain limited, reflecting SCPs' complementary role in the near term. However, advances in fermentation technology, strain development, and commercial deployment are enabling growth in production capacity, positioning SCPs as a credible alternative to fishmeal in the long term. SCP production could grow from ~40,000 MT in 2025 to 150,000–500,000 MT by 2030, driven by continued capital investment.

Decoupling protein production from wild fisheries

SCPs decouple marine protein production from wild fisheries and, in some systems, from land-based agriculture. This reduces pressure on finite marine and natural resources. Greenhouse gas emissions can be comparable to, or lower than, fishmeal when renewable energy and circular feedstocks are used. SCPs can also improve food safety by eliminating the marine bioaccumulation pathways responsible for contaminants in marine consumer products, including heavy metals, dioxins, and PCBs.

Industry at a Glance: Single-Cell Proteins

GLOBAL SINGLE-CELL PROTEIN (SCP) PRODUCTION FORECAST



Up to 12.5x more supply by 2030

SCP production is forecast to increase up to 12.5 times by 2030, reaching between 150,000–500,000 MT.

NUTRITION

Viable replacement of fishmeal up to **100%** in shrimp and **50%** in fish.

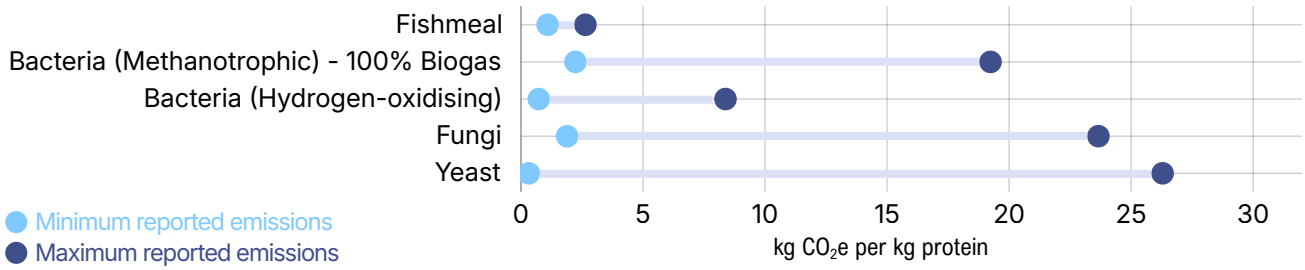
PRICE

USD 1,500 per MT

for methanotrophic bacteria priced within the historical range of high-quality fishmeal.

GREENHOUSE GAS EMISSIONS

Gas-based bacteria, yeast, and fungi can **match or outperform** fishmeal's footprint, particularly when using industrial waste streams.



ECOSYSTEM BENEFITS

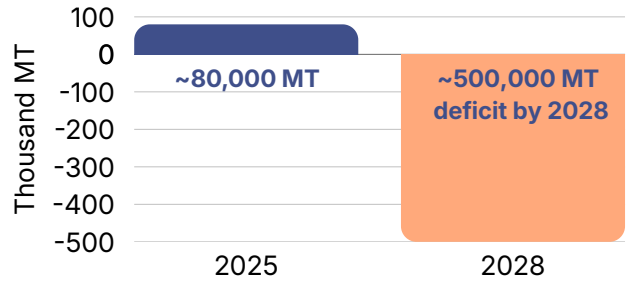
6:1

1 tonne of SCPs can replace the protein from up to 6 tonnes of wild-caught fish.

CIRCULARITY

SCPs can utilise waste streams, such as methane, methanol, off-gases, molasses, whey, and lignocellulosic hydrolysates.

PROJECTED FISHMEAL DEFICIT



SCP PRODUCTION COSTS

USD ~1,000–1,800 per MT

by leading SCP production at commercial maturity, such as methanotrophic bacteria, yeast fed on sugars or residues.

ASSESSMENT: SINGLE-CELL PROTEINS

Traffic-light assessment of single-cell proteins as a replacement for fishmeal in aquafeeds.

Nutrition		
Nutritional Composition	🟢	Protein content up to 81% (DM), comparable to or exceeding fishmeal.
Health & Growth Outcomes	🟢	Supports up to 100% fishmeal replacement in shrimp and up to 50% in some fish species, with maintained or improved growth and health.
Product Quality	🟡	May improve fillet colouration, but texture and taste can be altered at high inclusion levels.
Scalability		
Unit Cost Competitiveness	🟡	Methanotrophic bacteria price reported at ~USD 1,500 per MT, broadly competitive with fishmeal; other SCP pathways may be less competitive.
Capital Intensity	🔴	Capital costs are high: USD ~10k–12k per MT of capacity at smaller scales, falling below USD 3k per MT at larger scales.
Market Integration	🟡	Present in some aquafeed formulations, adoption remains limited due to high costs, low supply, and need for further commercial validation.
Scale and Volume Growth Potential	🟢	Projected to grow to 150k–500k MT by 2030, driven by advances in fermentation technology, strains, and commercial deployment.
Sustainability		
Climate Change Impact	🟢	Can achieve comparable or lower greenhouse gas emissions than fishmeal when using waste-derived feedstocks or renewable energy.
Land Use	🟡	Generally increases land use relative to fishmeal; some yeast and bacteria can achieve comparable or lower land use.
Water Use	🟡	Generally increases water use relative to fishmeal; some bacteria can achieve comparable or lower water use.
Safety		
Regulation	🟡	Approved in many key markets, some regulatory gaps remain.
Food Safety	🟢	Lower contaminant and pathogen risk than wild-caught fishmeal.
Ecological Safety	🟢	Produced in closed, controlled systems, offering a more contained ecological risk profile than marine-sourced fishmeal.

🟢 Strong; limited constraints 🟡 Developing; moderate constraints 🔴 Weak; significant constraints

BARRIERS TO ADOPTION

SCPs have emerged as a credible alternative to fishmeal in aquafeeds, but large-scale adoption is constrained by several factors. These factors reflect a mix of challenges related to investment, unit economics, sustainability, and operations.

1. **Capital intensity:** Commercial production facilities require significant upfront investment, with smaller plants facing disproportionately high unit costs. This creates financing hurdles that may slow the pace of capacity expansion.

2. **Feedstock availability:** The most competitive SCP systems rely on access to low-cost, consistent, and often circular inputs that are both finite and unevenly distributed, limiting where production can be successfully implemented at scale.

3. **Operating costs:** Production economics are highly sensitive to energy prices, exposing SCP systems to regional variability and reinforcing the importance of co-location with low-cost and renewable energy sources.

Scaling production is the path to price competitiveness

Achieving price competitiveness at an industrial scale is the defining challenge for the SCP sector. To compete in aquafeed markets, SCPs will need to both lower product costs and ensure consistent performance at an industrial scale.

The joint venture models deployed by industry leaders, which combine industrial partners, state-backed capital, and access to low-cost gas inputs, demonstrate a credible pathway to address this challenge. Under favourable conditions of economies of scale and process optimisation, production costs can fall significantly, materially closing the gap with fishmeal pricing.

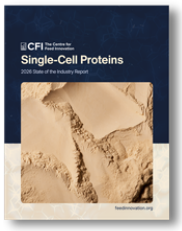
PATH FORWARD

CFI recommends that the SCP industry, the aquaculture sector, investors, policymakers, and regulators take coordinated action to accelerate SCP adoption. Closing the gap between early commercial deployment and full-scale market integration will require shared commitment across the aquaculture value chain.

Recommendations

SCP PRODUCERS	Improve strain efficiencies, use renewable energy, and co-locate production near low-cost, circular feedstocks to improve unit economics and sustainability performance.
AQUAFEED PRODUCERS	Expand partnerships with SCP suppliers to further validate performance and scale SCP use through long-term offtake agreements.
INVESTORS	Support large-scale production facilities that help suppliers achieve economies of scale and accelerate commercial deployment.
POLICY MAKERS	Expand regulatory approvals in key markets and implement supportive financing for novel feed ingredients.
CIVIL SOCIETY	Increase awareness of SCPs' climate, safety, and biodiversity benefits to inform consumer demand.

Read CFI's Single-Cell Proteins State of the Industry report here



About CFI

The Centre for Feed Innovation is an independent think tank that is accelerating the development of novel feed ingredients. We provide insights to drive innovation in sustainable, scalable, and safe animal feed ingredients. Support our work here.

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