Kingdom of the Netherlands

# BLACK SOLDIER FLY

## as Sustainable Alternative

Embassy of the Kingdom of the Netherlands in Vietnam

September 2025

# LIVESTOCK AND AQUACULTURE SECTOR

## Livestock sector

Vietnam's livestock industry continues to show dynamic growth, underpinned by a nationwide network of over 14,000 livestock farms. Several disease epidemics on livestock have been under control while market pricing increases

By 2025, the national herd comprises over 26 MN pigs, 576 MN poultry, 2 MN buffaloes, over 6 MN cattle and nearly 3 MN of goats and sheep

Poultry and swine production are increasingly shifting from small-scale household farms toward large-scale commercial operations, leveraging modern farming techniques and technologies. In contrast, buffalo and ruminant farming remain traditional, predominantly relying on backyard farming practices, using natural feed sources rather than commercial feeds

**Vietnam livestock population, production and growth,** 2024, MN and % y.o.y

| Category | Species | Population (MN Heads) | Growth % | Production (MN MT) | Growth % |
|---|---|---|---|---|---|
| Swine | Hog & Sow | 26 | +3.8% | 5.0 | +4.2% |
| Poultry | Broiler chicken | 471 | +3.1% | 1.9 | +8.5% |
| | Duck & Others | 106 | +3.3% | 0.5 | -7% |
| Buffalo | Buffalo | 2 | -4.9% | 0.1 | +1.8% |
| Ruminant | Cattle | 6 | -1.9% | 0.5 | +2% |
| | Goat & Sheep | 3 | 0.7% | 0.04 | +4.8% |

*Source: GSO, Vietnam Husbandry*

**Swine** population was estimated at 27 MN heads, with meat production reaching 5 MN MT in 2024, a 4% y.o.y growth in both figures

Swine farming is widespread nationwide. Major production hubs are located in Northern Midlands and Mountain areas, South East and Noth Central & Central Coastal areas, each accounting for 20-22% of total production. Key provinces include Dong Nai with 1.9 MN, Binh Phuoc 1.6 MN & Hanoi 1.3 MN heads

**Poultry** population amounted to 576 MN heads, a 2.8 % y.o.y increase. Broiler chickens comprise the majority at 80% of total population, accounting for 471 MN heads. Duck and others collectively numbered 106 MN. Chicken meat production rose to 1.9 MN MT, surged by 9% y.o.y, while duck & other poultry meat declined by 7%

Poultry farming is clustered in Red River Delta, Northern Midlands and Mountain areas, Noth Central & Central Coastal regions, with the top provinces including Ha Noi 37 MN, Nghe An 37 MN, Thanh Hoa 28 MN and Tien Giang 21 MN heads

**Buffalo** population registered 2 MN heads, a 5% decline from previous year. Meat production from buffaloes remained modest at 0.1 MN MT

**Cattle** population exceeded 6 MN heads, comprising 95% meat cows and 5% dairy cows, with respective cattle population at 5.9 MN and 0.3 MN heads. The total beef production was estimated at 0.5 MN MT

Cattle farming is predominantly located in North Central and Central Coastal areas, accounting for the highest production output of ~40% of the total population. Leading provinces of cattle production include Nghe An (550K cattle heads), Binh Dinh (307K), Quang Ngai (269K), Thanh Hoa (203K)

**Goat & Sheep** population volume remains relatively steady at nearly 3 MN heads. Meat production from this segment was recorded at 0.04 MN MT

# LIVESTOCK AND AQUACULTURE SECTOR

## Aquaculture sector

Vietnam's fishery sector, evolving from small-scale, self-sufficient operations, has demonstrated steady growth in recent years and remains a fundamental pillar of the national economy

By 2024, the total fishery production stood at 9.6 MN MT, marking a 3.4% increase y.o.y. Of this, Capture fisheries production reached nearly 4 MN MT, up by 0.9% y.o.y., with key species including tuna, salmon, and anchovy. Aquaculture production attained 5.7 MN MT, growing by 5% y.o.y

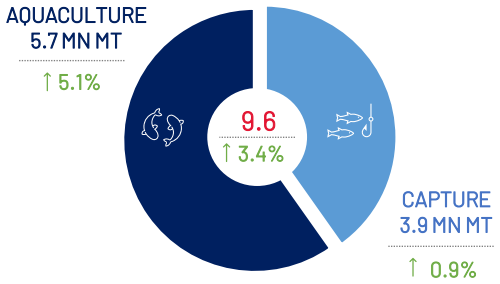
Over the past five years, Aquaculture production expanded more rapidly and now accounts for 60% of total fishery output, while Capture fisheries have remained relatively stable during this period, contributing the remaining 40%

By type of species, farmed fish and shrimp account for the majority of aquaculture output production, constituting 70% and 19%, respectively, together totaling around 5.2 MN MT.

Other aquatic species, comprising eel, frog, make up the remaining 11%, exceeding 0.6 MN MT in 2024

By 2030, Vietnam's Aquaculture production is projected to reach approximately 7 MN MT from 5.7 MN MT today.

**Vietnam Fishery production volume,** 2024, MN MT and % y.o.y




**Capture production,** 2024, MN MT and % y.o.y

| Product | Volume (MN MT) | Growth % |
|---|---|---|
| Sea catch total | 3.7 | 1.1% |
| *Of which: Fish* | *2.8* | |
| Inland catch total | 0.2 | -1.8% |
| **TOTAL** | **3.9** | **0.9%** |

**Aquaculture production,** 2024, MN MT and % y.o.y

| Product | | Volume (MN MT) | Growth % |
|---|---|---|---|
| **Marine aquaculture** | | **0.8** | 5.3% |
| Fish | | 0.05 | 4.3% |
| Mollusk | | 0.46 | 4.5% |
| Other species | | 0.32 | 6.7% |
| **Inland aquaculture** | | **4.9** | 3.5% |
| **Brackish water farming** | | 1.72 | 1.5% |
| Fish | | 0.08 | 0% |
| Shrimp | P.Monodon | 0.28 | 3.2% |
| | L.Vannamei | 0.98 | 6% |
| | Others | 0.06 | n/a |
| Other species | | 0.32 | -3% |
| **Freshwater farming** | | 3.2 | 4.6% |
| Pangasius catfish | | 1.8 | 4.3% |
| Tilapia | | 0.3 | 0% |
| Others | | 1.1 | 6.4% |
| **TOTAL** | | **5.7** | **5.1%** |

*Source: GSO, Vietnam Husbandry*

# LIVESTOCK AND AQUACULTURE SECTOR

## Aquaculture sector

Vietnam's Aquaculture production is clustered in Mekong River Delta (MRD), while production in other regions remains dispersed and comparatively minor

MRD generates over 70% of the country's total aquaculture output, predominantly farming shrimp and pangasius.

Following MRD, Red River Delta (RRD) accounts for 16% share, with a focus mainly on bivalve species like clams and oysters. North Central & Coastal make up 6%, specializing in lobster and marine fish farming

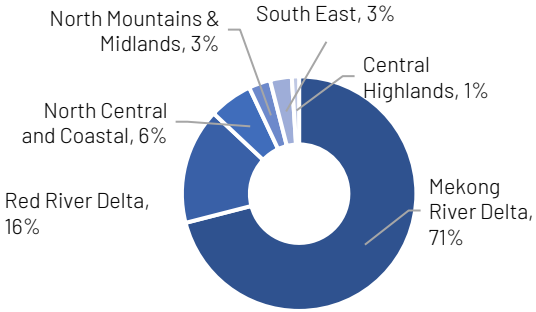
Vietnam's seafood and aquaculture exports exceeded 10 BN USD, marking a robust growth of 12% y.o.y.

The industry surpassed its official target and continues to solidify Vietnam's status as world's 3rd largest exporter, supplying to major markets such as China, US, Japan, South Korea and the EU

In terms of aquaculture consumption, more than 90% of pangasius and vannamei shrimp harvests are oriented for export markets

Other species, such as monodon shrimp, tilapia and snakehead fish are traditionally mainly consumed in the domestic market, but their export shares have been increasing over the years

**Aquaculture Production by region,** 2024, % total




**Consumption of key aquaculture products,** 2024e

| Product | Domestic | Export |
|---|---|---|
| White-leg shrimp | 10% | 90% |
| Black tiger shrimp | 65% | 35% |
| Pangasius | 10% | 90% |
| Tilapia & red tilapia | 80% | 20% |
| Snakehead fish | 50% | 50% |

**Export value of key products**, 2024, BN USD

| Product | Value | % Growth |
|---|---|---|
| Shrimp | 3.9 | 14% |
| Pangasius, basa | 2 | 10% |
| Tuna | 0.98 | 17% |
| Squid & Octopus | 0.66 | 0% |
| Crab & Other Crustaceans | 0.33 | 56% |
| Others | 2.2 | 6% |
| **TOTAL** | **10.07** | **12%** |

**Export value by region,** 2023-2024, BN USD

| Country / Region | 2023 | 2024 |
|---|---|---|
| China & Hong Kong | 1.33 | 1.9 |
| US | 1.55 | 1.8 |
| Japan | 1.51 | 1.5 |
| EU | 0.87 | 1 |
| South Korea | 0.79 | 0.86 |
| Others | 2.92 | 3 |
| **TOTAL** | **8.97** | **10.07** |

*Source: GSO, Vietnam Fisheries, Custom*

# COMMERCIAL FEED SECTOR

## Production & Exports

Vietnam has about 270 facilities engaged in commercial feed production with a total designed capacity of 43.2 MN MT, in which 160 aquafeed facilities with a total designed output of nearly 12 MN MT as of 2024

Actual commercial feed production reached nearly 27 MN MT in 2024, including 21.5 MN MT of livestock feed and 5.39 MN MT of aquatic feed, equivalent to 70% and 45% of the designed capacity in their respective feed sectors

Domestic commercial livestock feed production regained traction after Covid-19, increased by 3.4% y.o.y in 2024, with a forecasted growth at 2.6% to over 22 MN MT in 2025. Swine feed and poultry feed contribute significant shares of the overall livestock feed production, at 55% and 41% respectively

Concerning the aquafeed sector, total output reached 5.39 MN MT. Fish feed accounting for the largest share at 37%, shrimp at 26% and other species accounting for 36%

Regionally, 40% of all facilities are located in the Northern region, 30% in the Southeast, nearly 15% in the Mekong Delta region, and the rest are scattered across the country

About 30% of the total feed mills are FDI enterprises and 60% are local enterprises. Over 80% of facilities applied quality management systems such as ISO, GMP, HACCP or equivalent

In 2024, Vietnam's exports of animal feed and raw materials reached 1.05 BN USD, marking a 13% decline compared to 2023, with China, the US, and Cambodia as the main destinations

**Livestock Feed Production,** 2024, MN MT

| Species | 2024 | % share |
|---|---|---|
| Swine | 11.9 | 55% |
| Poultry | 8.8 | 41% |
| Others | 0.8 | 4% |
| TOTAL | 21.5 | 100% |

**Aquafeed Production,** 2024, MN MT

| Species | 2024 | % share |
|---|---|---|
| Pangasius | 2.02 | 37% |
| Shrimp | 1.4 | 26% |
| Others | 1.97 | 36% |
| TOTAL | 5.39 | 100% |

**Vietnam main animal feed producers**

| Company | Feed species | Country of Origin | Establish Year | Capacity (MN MT) | Feed mills in Vietnam |
|---|---|---|---|---|---|
| De Heus |  | Netherlands | 2008 | 8 | 23 |
| C.P Group |  | Thailand | 1993 | 4.5 | 10 |
| Japfa |  | Indonesia | 1999 | 2.2 | 8 |
| GreenFeed |  | Vietnam | 2003 | 2 | 9 |
| Mavin |  | Vietnam | 2004 | 1.5 | 6 |
| Sunjin |  | Korea | 2004 | 1.3 | 5 |
| Cargill |  | USA | 1995 | 1.2 | 12 |
| CJ |  | Korea | 2001 | 1 | 6 |
| Dabaco |  | Vietnam | 1996 | 0.8 | 6 |

*Source: Vietnam Husbandry, GSO, Department of Fisheries*

# COMMERCIAL FEED SECTOR

## Key characteristics

In 2024, Vietnam imported nearly 22.4 MT of animal feed ingredients for 7.7 BN USD, representing nearly 80% of country's total commercial production

The domestic feed industry remains substantially dependent on imported raw materials, notably protein-dense inputs such as soybean meal and fishmeal, along with energy-providing commodities including corn, wheat, and bran derivatives from copra, canola, and rapeseed

Specifically, corn accounts for approximately 56% of total feed ingredient imports, wheat for 25%, and soybeans for 6%, collectively comprising around 87% of all imports in this category

The total imported volume in 2024 of raw materials (corn, wheat, and soybean meal) significantly increased, suggesting a continuous rise in demand for these protein-dense inputs

In recent years, increasing and volatile prices of imported feed ingredients have placed mounting pressure on Vietnam's feed millers and aquaculture sectors. Although 2024 witnessed some relief, with corn and soybean meal prices falling nearly 20% year-on-year, underlying cost volatility remains a persistent challenge, especially for wheat and fishmeal

Vietnam's feed supply chain remains anchored to a narrow set of commodity imports, with corn, wheat, and soybean meal are predominantly from Brazil, Argentina, and the United States, while fishmeal—sourced both domestically and internationally—covers roughly half to two-thirds of demand

Even with recent easing in corn and soybean meal prices, ongoing cost volatility alongside steadily rising feed demand continues to challenge the sector. As Vietnam's livestock and aquaculture industries grow, ensuring stable and affordable supply may call for greater flexibility in sourcing and more balanced use of feed ingredients

**Key feed ingredients**

| Ingredients | Domestic supply, % | Main Source of Imports | Estimated % used feed | | |
|---|---|---|---|---|---|
| | | | Swine | Poultry | Aqua |
| Wheat | 0% | Australia, Canada | 5-10% | 5-8% | 15-20% |
| Corn flour | ~ 20% | Brazil, Argentina, India | 40% | 45% | - |
| Soybean meal | ~ 20% | Argentina, USA, Brazil | 15-25% | 20-30% | 20-30% |
| Fishmeal | ~ 60% | Peru, USA | 5-8% | 5-10% | 8-20% |
| Rice bran | ~ 90% | - | 20-30% | 20-25% | 35-50% |

**Import of Key Raw Materials for feed sector,** 2024, % y.o.y change

| Ingredients | Volume (MN MT) | Value (BN USD) | Avg. Price (USD/MT) | % y.o.y change | | |
|---|---|---|---|---|---|---|
| | | | | Volume | Value | Price |
| Corn | 12.5 | 3.04 | 243 | 29% | 6.1% | -18% |
| Wheat | 5.7 | 1.58 | 275 | 23% | 1.2% | NA |
| Soybean meal | 2.2 | 1.13 | 508 | 19% | -3.6% | -19% |
| Fishmeal | 0.12 | 0.11 | 917 | -20% | NA | NA |
| Others | 1.88 | 1.95 | - | - | - | - |
| **TOTAL** | **22.4** | **7.7** | **-** | **-** | **-** | **-** |

*Source: GSO, Vietnam Husbandry, Custom*

# KEY ADVANTAGES OF BSF

## Across Nutritional, Environmental, Social and Economic aspect

As global demand for animal protein continues to rise, traditional feed ingredients such as fishmeal and soybean meal face mounting pressure due to environmental degradation, supply chain volatility, and increasing competition for agricultural land and marine resources

The COVID-19 pandemic further highlighted the fragility of global feed supply chains, accelerating the need for resilient and locally producible alternatives. In this context, BSF has emerged as a highly promising solution. By converting organic waste into high-quality protein and fat, BSF offers substantial nutritional, environmental, social, and economic advantages, contributing to the development of more circular, self-reliant, and sustainable food systems

However, while the potential is clear, the sector still faces critical challenges around nutrient consistency, scale-up logistics, and cost parity with conventional ingredients. Without coordinated investment, regulatory support, and integration into commercial feed supply chains, BSF risks remaining a niche solution rather than a mainstream alternative. Realizing its full potential will require targeted collaboration between innovators, policymakers, and market players

As the global feed industry shifts toward sustainability, BSF protein stands out as a high-impact and multi-benefit solution. Its strong nutritional profile, environmental performance, and emerging cost efficiency position BSF as a strategic component in building resilient, circular, and localized feed systems—particularly in fast-growing markets such as Vietnam

### Nutritional protein source for commercial feed

BSF offers substantial nutritional and functional advantages, making it a promising and sustainable alternative protein source for animal feeds. Its protein is particularly well-suited to monogastric species—including poultry, aquaculture species, and companion animals—where high-quality, highly digestible protein is critical for early-stage diets and optimal growth

BSF's favorable amino acid composition, high digestibility, and palatability make it an effective partial replacement for conventional feed ingredients such as fishmeal and soybean meal, as well as animal-derived proteins

BSF inclusion in diets has shown potential to improve feed conversion ratios (FCR) and enhance disease resistance in tilapia and broiler chicken thanks to its antimicrobial peptides, lauric acid, and chitin—which support gut health, boost immunity, and improve nutrient absorption.

### Reducing emissions associated with logistics

BSF farming can be established in decentralized, small-scale, or industrial facilities located close to organic waste sources. This localized production reduces transportation distances and emissions associated with logistics

In contrast, soybean and grain products are frequently imported from across the globe such as the Americas and Europe, where long-haul transportation contributes significantly to greenhouse gas emissions

*Source: Compilation from desk and field research*

# KEY ADVANTAGES OF BSF

## Across Nutritional, Environmental, Social and Economic aspect

### Waste upcycling

Using BSF larvae to recycle organic waste material or biowaste is gaining traction due to its remarkable ability to reduce organic waste volumes. BSF larvae are efficient bioconverters that transform a wide range of organic materials, including fruits, vegetables, carcasses into nutrient-rich biomass, making them ideal candidates for sustainable waste management. BSF larvae are efficient feeders, requiring 4.5 to 10 kg of organic waste-to-produce 1 kg of larvae biomass

After harvesting larvae, the material that remains contains a mix of frass, known as larvae's excrement, exoskeletons, and residue of organic material fed to the larvae, which is a valuable by-product commonly used as soil amendment

### Reducing pressure on marine resources sustainably

There are currently two main sources of fishmeal production, either from wild-caught fish and aqua-processing by-products

Harvesting wild fish for fishmeal puts heavy strain on marine ecosystems, depleting forage fish vital to ocean food webs—taking 4 kg of wild fish to make just 1 kg of fishmeal. This overfishing reduces biodiversity and disrupts ecological balance, with cascading effects on marine productivity. Replacing part of this demand with BSF meal offers Vietnam, a leading fishmeal producer, a more sustainable pathway that eases pressure on natural marine resources

### Circular economy enabler

BSF farming is at the forefront of the circular economy movement by creating a closed-loop system that minimizes waste and maximizes resource efficiency

This approach supports regenerative, low-waste agricultural practices and fosters integration between food production, animal feed, and organic waste management sectors, paving the way for a more sustainable and resilient agricultural ecosystem

### Low land and water footprint in feed's raw materials production

Compared to primary feed ingredients like soybean meal and fishmeal, BSF cultivation demands substantially less land, water, and feed inputs, resulting in a markedly lower carbon footprint

### Social job creation

Scalable across regions, BSF farming has strong potential to generate employment at every stage of the value chain—from feedstock collection and sorting, to larval rearing, processing, and feed manufacturing. Its decentralized production model makes it well-suited for rural areas, where small- to medium-scale farms can provide steady income opportunities, promote local entrepreneurship, and engage marginalized groups

By integrating with local waste streams, BSF operations can also stimulate related service industries, creating a multiplier effect that extends beyond direct farming jobs

*Source: Vietnam Fishery, WWF, compilation from desk and field research*

# KEY ADVANTAGES OF BSF

## Across Nutritional, Environmental, Social and Economic aspect

### Reducing import dependency

Expanding local BSF production has the potential to reduce Vietnam's reliance on imported raw materials used in feed production, including corn, soymeal and fishmeal, supporting Vietnam's food sovereignty goals

Corn flour remains the primary ingredient across both livestock & aquafeed sectors. Currently, domestic production satisfies only about 20% of total demand, with the remainder largely imported from Brazil and Argentina

Soybean meal, the main protein source in feed formulations, is mostly imported as domestic supply can only fulfill 20% of national demand

Fishmeal is primarily used in aquafeed and to a lesser extent in livestock feed to enhance nutritional quality. It is mainly produced from domestic fisheries & aquaculture by-products, supplying 60% of total demand

Moreover, geopolitical factors such as armed conflicts can directly disrupt supply chains, surging volatility and underscoring the risks of heavy reliance on foreign raw material sources. By fostering domestic BSF production, Vietnam can reduce exposure to these risks while contributing to its environmental and sustainability objectives

### Potential economic advantage

During the initial stages, BSF was attached to the impression of an expensive ingredients, costing far more than conventional material like corn, soymeal, and fishmeal. In 2016, BSF prices averaged around 8,000 USD/MT, as the production was small-scale, overhead costs were high, and supply was limited, making it a niche ingredient in feed formulations

Fishmeal has continued to hold a cost advantage for most feed millers thus far, particularly in lower-margin feed sectors such as swine and poultry, where incorporating BSF meal into formulations has not yet been economically viable at scale

Nonetheless, with advances in technology and the entry of larger industry players, modern large-scale BSF farming has significantly reduced costs by lowering overheads and improving efficiency, making it more accessible while delivering greater nutritional value

With continued progress in scaling, process optimization, and waste-to-protein conversion efficiency, the cost gap between BSF meal and fishmeal is expected to narrow significantly over the next decade. This trajectory positions BSF protein as a competitive, sustainable alternative in the global animal feed ingredient market

*Source: Vietnam Fishery, Compilation from desk and field research*

# REGULATORY FRAMEWORK

## Current relevant legislations and national visions

### BSF Farming and Feed

Effective from July 13, 2022, Decree 46/2022/ND-CP amended Decree No. 13/2020/NĐ-CP formally added the Black Soldier Fly (Hermetiaillucens) to the list of "other animals permitted for rearing"

The official recognition provides legal certainty, making it easier for businesses to obtain licenses, attract investment, and scale up operations. This policy decision legitimized the sector, transitioning it from a niche hobby to a recognized agricultural industry

The sector is currently operating under general agricultural and environmental laws, with more specific regulations expected to be developed to support its rapid growth and ensure product quality and safety

Key aspects of BSF operations under consideration include,

- **Feedstock**: guidelines to dictate what can be fed to larvae to ensure the production of high-quality, safe BSF larvae for animal consumption and technical purposes (e.g., biodiesel, cosmetics)
- **Farming and handling of BSF:** BSF farms comply with national laws on animal husbandry, veterinary medicine, and environmental protection. This includes regulations on disease prevention, waste management, and the quality of animal feed ingredients
- **Use of BSF in feed**: While BSF larvae are a natural part of many animals' diets, regulations shall define whether they can be used in feed, along with requirements for processing, packaging and labeling
- **Export compliance:** Future regulations are expected to harmonize Vietnamese BSF standards with international requirements, facilitating the export of BSF products to markets such as the EU and the US

### Alignment with Development of Livestock and Feed Industry

Per Decision No. 1520/QD-TTg and Decision No. 1625/QD-TTg, Vietnam aims for a design feed production capacity of 40-45 MN MT and actual production 30-32 MN MT by 2030 while prioritizing the use of domestic alternative ingredients. This creates a favorable market for BSF-based products, which can facilitate reduce reliance on imported feed ingredients

### Promotion of Circularity, Climate Mitigation and Waste Management

Vietnam's broader push for circular economy and environmental protection has directly supported the BSF sector. Notable initiatives are,

- Vietnam's National Climate Change Strategy to 2050 (Decision No. 896/QD-TTg) commits the country to net-zero emissions by 2050. This plan sets ambitious targets for the agriculture sector—a 43% reduction in GHG emissions by 2030. BSF sector support achieve these goals by,

  Reducing Methane: BSF larvae efficiently process organic and agricultural waste, which would otherwise release methane, a powerful greenhouse gas

  Promoting Sustainable Feed: BSF can be used as an eco-friendly animal feed, lowering the carbon footprint of traditional feed production
- Decision No. 687/QĐ-TTg in 2022, approves the "Scheme on development of circular economy in Vietnam", sets goal for circular economy and waste management, creating strong market and incentive for BSF businesses
- The Law on Environmental Protection 2020 and Decree No. 08/2022/ND-CP establish Vietnam's waste management framework. By encouraging sustainable organic waste solutions, these directly support the adoption of BSF technology, enabling farms to earn revenue from both waste-processing fees and the sale of products

*Source: Vietnam Government Portal*

# STAKEHOLDER MAPPING

## Key Stakeholder Mapping & Products

**SUPPORTERS & INFLUENCERS**

- Government authorities
- Knowledge institutions
- Financial Institutions
- Laboratory & Quality Control

**VALUE CHAIN**

| Input | Breeding | Farming | Primary Processing | Value-added Processing | End-user | Products |
|---|---|---|---|---|---|---|
| Feedstocks & Technologies suppliers | Hatchery Farms | Larvae Farms | | | Smallholders | Fresh & Dried larvae |
| | | Processors | | | Commercial Feed millers | Meal |
| | | | | | | Oil |
| | | | | | | Frass |

# STAKEHOLDER ANALYSIS

## Value Chain Stakeholders

The BSF value chain is multi-stakeholder and interdependent, including below key stakeholder groups

**Input** suppliers, including technology and feedstock providers, are involved from the beginning of the BSF farming process

Technology suppliers provide the necessary machines and solutions for farms and processors, while feedstock suppliers are responsible for providing the organic substrates for rearing the larvae. Some notable companies are:

- Technology suppliers: Vina Organic, Hai An Phat
- Feedstock suppliers: Mondelez International, Heineken

**Hatchery farms** sell BSF eggs to larvae farms and processors

The demand for BSF eggs has boomed in recent years, as the push for a circular economy has encouraged livestock farms to buy BSF eggs for on-site waste management and animal feeding. Hatchery farms are concentrated in Dong Nai, Tien Giang and Gia Lai. Some notable farms are:

- BSF Smart, Kimmy Farm, Huy Tam, An Dong Feed

**Larvae farms** primarily sell fresh larvae for daily consumption to smallholder farms located nearby, usually within a 10km radius, to feed poultry, frogs, and swine. Many farms process fresh larvae into dried form on-site and sell to more distant buyers. Farms hardly sell to processors due to current limited scale

Farms also sell their residue, including frass, skins, and uneaten substrate, to smallholder farms to be mixed and used as fertilizer

Larvae farms are primarily concentrated in the Southern provinces, where offers favorable climate for BSF rearing and abundant supply of agricultural, agri-food, and brewery by-products. Notable farms are:

- Hai To, BSF Smart Farm, Hung Dien Phat

**Processors** convert BSF into higher-value products like meal and oil, which they sell to domestic commercial feed millers or export to international markets, including premium ones like the EU, Japan, and South Korea

Vietnam has limited number of processors due to insufficient market demand and lack of advanced machinery and technology. Notable processors are:

- Larva Farm, BSF Smart Farm

In Vietnam, dominant companies often operate as **integrators**, managing multiple steps from breeding to value-added processing. This integrated model provides enhanced control over value chain, ensuring quality and traceability

A notable integrator is Entobel, a global leader in insect protein. Entobel operates two production sites: one in Vung Tau, which is cited as one of Asia's largest insect production plants with a design capacity of 10,000 MT, and a second site in Dong Nai, which now serves primarily as R&D center

**End-users** of BSF products include smallholder farms, commercial feed millers, and occasionally research institutes focused on protein innovation. These users integrate BSF into their feed formulations. Notable feed millers are:

- De Heus, Vinh Hoan, Skretting

While pet food companies are notable end-user in global markets, no company in Vietnam has yet announce use of BSF in their products

# STAKEHOLDER ANALYSIS

## Supporter & Influencer stakeholders

**Government authorities** draft and enforce laws and regulations that govern the entire value chain

- Ministry of Agriculture and Environment (MOAE) responsible for issuing and overseeing regulations for BSF farming. This includes the legal framework that officially permits the rearing of BSF (Decree No. 46/2022/NĐ-CP)

  As BSF sector is primarily serve feed industry, MOAE sets and enforces standards for the quality and safety of BSF-derived products

  MOAE also regulates the use of BSF for organic waste treatment and compliance with environmental laws and guidelines related to waste handling, pollution control, and the disposal of residue

- Ministry of Industry and Trade (MOIT) hold critical role in the commercial and trade aspects. MOIT is responsible for the trade policies and regulations related to the import and export

- Ministry of Health (MOH) While not as directly involved, the MOH sets general food safety standards and may get involved in the regulation of BSF-derived products if they are processed for human consumption or if they are used in products that could impact public health

**Laboratory & Quality Control** ensure the safety, quality, and market viability of products. The key functions include nutritional analysis, safety and contaminant screening, certification and compliance. Notable providers are:

- ShrimpVet, Control Union, Eurofins, VinaCert

**Knowledge institutions** conduct studies, trials and developing techniques. They contribute to the research and validation needed to optimize feed formulations, nutrient profiles, and benefits like digestibility and palatability. Knowledge institutions with BSF studies include:

- Nong Lam University (HCMC): focus on developing farming protocols and partnering with local governments in Dong Nai and Tien Giang to organize training workshops and transfer farming techniques to local farmers

- Hue University of Agriculture and Forestry (Thua Thien - Hue): focuses on BSF applications in aquaculture, particularly in the Central and Central Highlands regions. Their research has explored the use of BSF larvae as a cost-effective and nutritious feed for freshwater fish and frogs

- Vietnam National University of Agriculture (Hanoi) conducted the genetic diversity of BSF populations across Vietnam. The research identified a relatively high genetic diversity, which is a valuable finding for breeding programs, informing selective breeding, helping to develop lines of BSF that are more resilient, grow faster, or have a more desirable nutritional profile

**Financial institutions**, including investors and donors, finance business operations and enabling the sector scale up. Notable institutions include:

- Vietnam Bank for Agriculture and Rural Development (Agribank): has launched numerous preferential credit packages to support clean and sustainable agricultural production. For instance, a 50,000 BN VND (~2 BN USD) credit package effective from April 2025, offers loans at lower-than-standard interest rates for environmentally conscious and tech-driven farming models, which could be accessible to BSF businesses

- Mekong Capital, Dragon Capital and The International Finance Corporation (IFC) with their investment in Entobel

# BSF PRODUCTION LANDSCAPE

## Benchmarking Global and Vietnam's models

As global demand for alternative proteins accelerates, BSF farming has evolved into a diverse array of production systems tailored to varying socio-economic, climatic, and regulatory conditions

Models range from low-cost, smallholder setups in East Africa that rely on open-tray rearing for on-farm feed, to fully automated, climate-controlled industrial plants in Europe and Asia producing standardized protein meal and oil for commercial feed markets

Broadly, BSF production can be categorized into 04 production system models, each with its own business scale, core features, advantages, and limitations

This diversity highlights BSF's adaptability as a circular solution for organic waste valorization and sustainable animal feed production, with success hinging on how well waste sources, climate, regulations, and production scale align with the chosen farming model

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In Vietnam, insect-based feed has historical roots — earthworms and other larvae have long been used on a small scale for poultry and fish farming in 90s

BSF was first introduced around 2015, when smallholder farmers began using larvae as a low-cost, locally available solution for managing organic waste and supplementing poultry diets

Since then, the sector has gradually expanded, developing into 02 models:

- Traditional smallholder systems, typically open-air or semi-covered trays with basic hygiene and minimal biosecurity, mainly for on-farm use
- Modern commercial facilities, often with automation, improved climate control, and standardized processing to meet safety standards

Global production system

| Production system | Scale & context | Key features |
|---|---|---|
| **Small-scale / decentralized** | Rural households, farmer cooperatives, small agri-entrepreneurs | ○ Manual or semi-automated<br>○ Operates on agri waste<br>○ Often uses crates or simple bio-systems |
| **Medium-scale commercial** | Emerging businesses in Asia, Africa, Latin America | ○ Semi-automated<br>○ Mix of local waste and pre-consumer food waste<br>○ In-house processing (drying, pressing) |
| **Large-scale industrial** | High-tech operations | ○ Fully automated climate control<br>○ Consistent feedstock (e.g., pre-sorted food waste)<br>○ Advanced biosecurity, R&D, traceability systems |
| **Integrated Agri-waste systems** | Often linked to other agri-industries | ○ Waste from own operations or partners<br>○ BSF as waste management + feed production |

# BSF PRODUCTION LANDSCAPE

## Current development

Since 1990s, insects farming of mealworms and superworms has long been established. These were mainly used for ornamental fish feed, reptiles, and niche pet markets and typically on small-scale farms

BSF was not found for feed, but rather another alternative to worms for poultry feed and trial for organic waste recycling , first being used in 2015

Opening the market for industrial scale in 2019, Entobel emerged as the first large-scale industrial player, establish as livestock and aquaculture feed supplier , attracting FDI and growing to operate the country's largest BSF facility

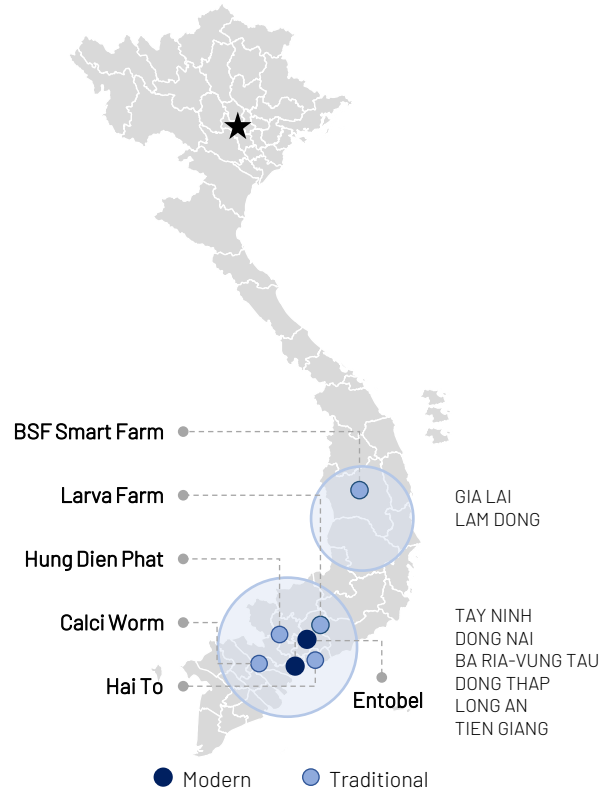
Today, modern and traditional models coexist, together advancing sustainable feed production and promoting rural economic inclusion across Vietnam

Geographically, BSF production in Vietnam is predominantly concentrated in the South Central and Southern regions, while the North and North Central areas host smaller-scale, more scattered operations

| Farm | Location | Production model | Processing capacity (MT/year) | Product Outputs |
|---|---|---|---|---|
| **Entobel** | BRVT<br>Dong Nai | Modern | 10,000 | Meal, oil, fertilizer |
| **Larva Farm** | Dong Nai<br>Tay Ninh | Traditional | 76 | Egg, dried larvae, meal, oil, frass |
| **Hung Dien Phat** | HCMC | Traditional | 140 | Dried larvae, meal, oil, frass |
| **Hai To** | BRVT | Traditional | 60 | Egg, dried larvae, meal, oil, frass |
| **Calci Worm** | Tien Giang | Traditional | 50 | Dried larvae |

*Note: 1,600 sqm Con Trau Eco farms are expected to be in operation in 2026 in Long An province*

Notable BSF larvae farms and production clusters



# CURRENT PRACTICES

## Production Yield

The current production yield of BSF farming varies across different phases, from eggs to final processed products

Typically, adult BSF female can lay approximately 800-900 eggs during lifetime. 1 gr of eggs which contains 8,000 - 10,000 individual eggs, can yield from 2 to 3 kg of fresh larvae, equivalent to conversion rate of 0.001:2

The typical incubation period for BSF eggs is 4-5 days. The newly hatched larvae then feed actively for 15-21 days. The success of this stage, including hatchability and growth rate, is highly dependent on feed quality and environmental factors such as temperature, humidity, and breeding conditions

Fresh larvae are then converted into dried product. This primary processing results in a significant reduction in mass due to the high moisture content of fresh larvae, which is around 70%. The typical conversion rate is 4:1, meaning 4 kg of fresh larvae are needed to produce 1 kg of dried larvae

The drying process removes moisture from larvae, resulting in a shelf-stable, nutrient-dense product. Dried larvae contain up to 40% fat and 42% protein, a higher concentration than fresh larvae (28-48% protein and 12-42% fat), which makes them ideal for feed applications

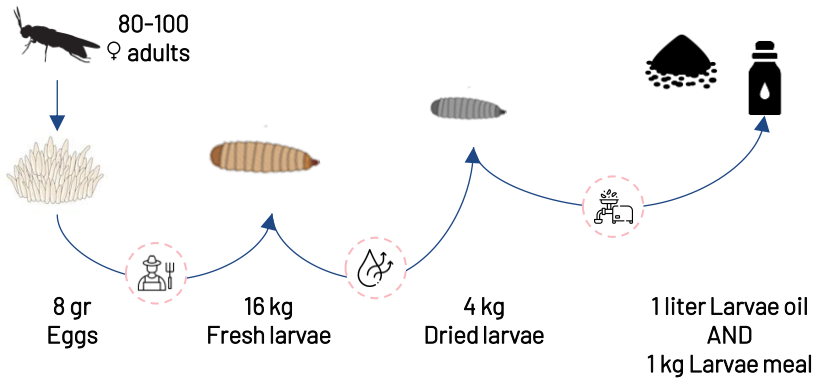
In the value-added processing phase, dried larvae are primarily processed into two products: oil and meal. A typical conversion rate is 4:1:1, in which 4 kg of dried larvae are required to produce approximately 1 liter of oil and 1 kg of meal

The oil is particularly valued for its high content of medium-chain fatty acids, while the remaining defatted meal, a high digestible protein powder, still retains 42% protein and 35% fat

Both products are considered highly nutritious and functional ingredients, suitable for feed formulations for livestock, aquaculture and pet food

Estimated BSF products conversion efficiency

| Conversion | Rate | Yield |
|---|---|---|
| **Hatchery**<br>BSF eggs → Fresh larvae | 0.001:2 | 0.001 kg Eggs yields<br>2 or 3 kg of Fresh larvae |
| **Primary**<br>Fresh larvae → Dried larvae | 4:1 | 4kg Fresh larvae yields<br>1kg Dried larvae |
| **Value-added**<br>Dried whole larvae → Oil & Meal | 4:1:1 | 4kg Dried larvae yields<br>1 Liter Larvae oil &1 kg of Larvae meal |



# CURRENT PRACTICES

## Breeding

Hatcheries are primarily run by small-scale, pioneering farmers. These farmers have been BSF farming since its early days in Vietnam, giving them the experience. There are currently few farms specializing solely in breeding, with most being smallholder operations

Hatching is conducted in dedicated greenhouse areas, typically 40-50m$^2$. These spaces are covered with plastic and mosquito netting to control temperature and humidity, which are critical for ideal hatching conditions. Wooden planks serve as the substrate for egg laying

Adult female BSF lay 800 - 900 eggs in the vicinity of decaying organic material, average mortality rate is around 10-15%. Some farms sell half their eggs while keeping the rest to sustain their own breeding cycle

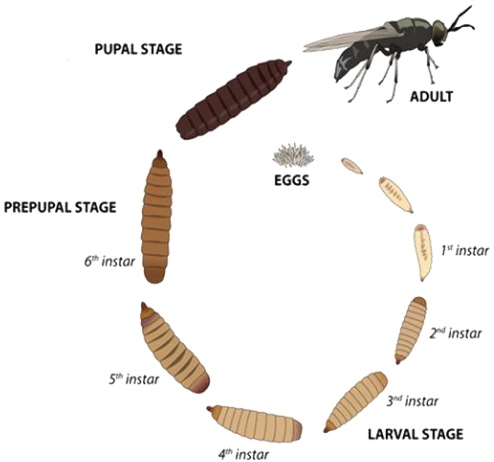
Hatching is most productive during the first nine months of the year, when temperatures are ideal (25-30°C). It is generally avoided in the last three months due to colder temperatures

Sellers advise the quantity of eggs benchmarking by the area of waste to be treated. In general, 1KG of eggs is typically needed for a 200m$^2$ poultry farm, which can be expected to yield up to 1 MT of fresh larvae

BSF eggs are available for purchase through on-site visits and social media platforms like Zalo and Facebook. Some sellers also use ecommerce sites, with delivery times of 1-2 days

The demand for BSF eggs has grown significantly since the government officially recognized BSF as a rearing animal and push for a circular economy. This encourage more farms to purchase for on-site waste management and to produce larvae for animal feeding

BSF Lifecycle




| Lifecycle Stage | Duration (days) | Key Process Steps |
|---|---|---|
| Egg → Larvae | 4 | Hatchery |
| Larvae → Pre-pupae | 15-21 | Feeding<br>Rearing (environment control for growth)<br>Harvesting |
| Pre-pupae → Pupae | 7-14 | Harvesting<br>Migrate for pupation |
| Adult | 5-8 | Breeding<br>Egg collecting |

*Source: Compilation from fieldwork, Fabo.org*

# CURRENT PRACTICES

## Farming

Since BSF sector has gradually expanded, BSF farms have been developing into 02 models:

**Traditional smallholder systems** typically manual and resource-efficient model primarily run by households and small cooperatives

The operations require minimal land (>100 $m^2$) and initial investment. They typically use open-air or semi-covered trays for rearing larvae, which allows for manual watering to control temperature and humidity

The hygiene standards are basic, and there is minimal biosecurity

BSF are often fed on organic food waste and agricultural by-products

In general, a traditional operation can yield approximately 100 kg of larvae daily

While some farms with the necessary equipment process fresh larvae into dried or frozen forms, few can afford to process them into meal

Larvae in fresh and dried forms are then sold as feed for animals such as chickens, frogs, and swine

This traditional model is a simple, low-cost solution for local communities. In recent years, local provincial governments have actively encouraged local farmers to integrate BSF farming into their operations. This push is part of broader national strategies that promote a circular economy, sustainable waste management, and development of sustainable feed

For instance, Dong Thap province, in collaboration with Nong Lam University, launched pilot projects to transfer BSF farming techniques to local farmers

**Entobel remains the only modern farm player**

In contrast, modern BSF operations are highly automated and capital-intensive, relying on industrial systems for processing larvae into high-value products like protein meal and oil

These facilities require significant land (>500$m^2$) and are typically run in enclosed, bio-secure environments to ensure consistency and quality

Key features of modern BSF farms include:

- Automated systems: Fogging, humidity control, and controlled light cycles
- Structured layout: The farms have partitioned breeding zones for a more efficient and controlled process
- Efficient waste processing: Advanced systems convert contracted organic by-products (from contractual breweries and agri-food waste) into high-quality feedstock

A modern operation can yield up to 5,000 kg of larvae daily

The processed products, such as protein meal and oil, are sold directly to commercial feed millers

Entobel is the sole major modern player in Vietnam's BSF sector today. The primary facility, located in Vung Tau, began operations in late 2023. It was financed mainly through a 30 MN USD Series B funding round, led by Mekong Capital, Dragon Capital, and the IFC

The facility features highly automated 50-level vertical rearing system that uses robotics and advanced sensors with annual design capacity of 10,000 MT meal

*Source: Compilation from fieldwork, Entobel*

# CURRENT PRACTICES

## Feedstock

BSF farms in Vietnam primarily use low-cost, locally sourced organic waste and by-products. This feedstock is readily available from farms, markets, and food processing facilities across the country

The type of feedstock used often depends on the farm's location and the local agricultural landscape

Farms in the Southeast and MRD provinces often rely on local farms for fruit, vegetable, and cashew by-products. In these areas, popular feedstocks also include soybean paste from soymilk producers, grains from breweries, and residues from processing peanuts and cashews

Meanwhile, farms in central provinces like Binh Thuan and Ninh Thuan prefer using cassava starch residue from monosodium glutamate (MSG) production

Some farms mix different feedstocks, depending on current availability

The collection of these by-products is typically handled by collectors who transport shipments ranging from hundreds of kilograms to tons

Feedstocks are commonly pre-treated with blanching or fermentation steps before feed to BSF larvae

To ensure a consistent supply, BSF farms aim to secure long-term agreements with agricultural farms and industrial facilities

Entobel and Heineken have a strategic collaboration to upcycle the brewery's spent grain. This partnership provides a traceable and approved feedstock for Entobel while advancing Heineken's sustainability goals

As a traditional agriculture country, Vietnam has massive volume of agricultural by-products and waste, estimated at 150-160 MN MT annually

Crop residues from post-harvest and processing activities make up the largest portion at 55%. This includes rice straw and husks 40-50 MN MT, followed by corn and cassava stalks 15-18 MN MT, vegetables and fruits 4-5 MN MT, and nuts and sugarcane 5-7 MN MT

The current recycled and reused rate of crop by-products is around 52%, 75% in livestock, 50% in forestry and 90% in fisheries

Both the government and private sector are actively promoting upcycling through a mix of national strategies and local projects, where BSF is considered a highly promising option

Common feedstocks for BSF




*Source: MOAE*

# CURRENT PRACTICES

## Relevant Technologies

Technology suppliers provide essential equipment and systems for both BSF breeding and processing

The machinery used for breeding and processing is generally simple and accessible as either domestically assembled or fully imported

Prices vary based on origin. A common 50 kg larvae dryer imported from China can cost up to 17,000 USD, while a domestically assembled version with a locally fabricated frame and imported core components costs around 5,000 USD. Both options come with a 12-24 month warranty

For the initial breeding and rearing phases, farms typically use four main types of machines including temperature and humidity sensors, misting system, ventilation fans and specialized lighting. These are crucial for maintaining the optimal environmental conditions necessary for BSF growth

Smallholder farmers usually buy greenhouse materials and equipment directly from local suppliers while large-scale producers often hire specialized contractors to build fully equipped greenhouses with integrated environmental sensors, with the contractor providing the warranty

Finom Vietnam is among notable supplier of greenhouse fogging and automatic control systems

After reaching harvest size, fresh larvae undergo several essential post-harvest processing steps to become a nutritious feed input. The main machines used are larvae-frass separators, larvae dryers, and vacuum packing machines

For primary processing, the larvae are separated from the rearing substrate using a vibrate or rotary drum. The larvae are either frozen or dried for long-term storage while remaining frass is collected for use as organic fertilizer

There are two main types of dryers: traditional hot-air systems for rapid drying, and modern cold-drying systems to better preserve nutrients

The drying process reduces the larvae's moisture content to below 10%, which prevents microbial growth and preserves its protein and fat content

Mactech and Vina Organic are notable suppliers of these dryers

For value-added processing, dried larvae are transformed into feed ingredients like protein meal and oil using technically complex machinery

The main equipment includes oil extractors and grinding machines, which require precise programming and calibration

These machines are relatively expensive and often custom-designed. For example, a grinding machine costs 2,000–3,000 USD, while an oil press costs 3,000 – 5,000 USD

The machinery is primarily imported from Japan, Europe, and China, with notable suppliers are Viteko, Binh Minh, Hai Minh, Vien Dong, and IntES

*Price collected as of July 2025*

# CURRENT PRACTICES

## Commercialization

BSF eggs are sold to larvae farms and integrators where they are incubated to produce BSF larvae, priced at 90 up to 160 USD per kilogram

From larvae farms, fresh larvae are sold to nearby smallholder farms at price ranging from 0.4 USD to 1 USD per kilogram, either fresh or chilled

To extend product shelf-life and enhance storage for later use, fresh larvae are usually sun-dried or oven-dried. The dried whole larvae are then sold to smallholder farms, serving as a sustainable feed ingredient for chickens, piglets and frogs. The average price of dried whole larvae is 3 USD per kilogram

Through grinding and cold-press method, dried whole larvae are transformed into larvae meal and larvae oil. These value-added products are primarily sold to commercial feed millers for integrating into livestock feed and aquaculture feed formulations, with larvae meal priced at 3 to 4 USD per kilogram and larvae oil at approximately 5 USD per kilogram

BSF frass, a nutrient-rich by-product from larval digestion, serves as organic fertilizer, contributes to soil improvement by enriching it with nutrients and beneficial microbes for crops

Frass is mostly sold in 20 kg bag by traditional farms at 0.4 USD per kilogram to some nearby cultivation farms. Some fertilizer companies' contract with BSF farm to purchase BSF frass for their fertilizer manufacturing, selling to organic horticulture and fruit farms at higher prices

| BSF Products | | Selling price (USD/kg) | Processing Method | Buyers/ Application |
|---|---|---|---|---|
|  | BSF Egg | 90 – 160 | Fresh | Larvae farm Integrators |
|  | Fresh larvae | 0.4 – 1 | Washed, chilled | Smallholders |
|  | Dried whole larvae | 2.6 - 3.5 | Oven/ Sun-dried | Smallholders |
|  | Larvae meal | 3 - 4 | Grinding | Commercial Feed millers |
|  | Larvae oil | ~5 | Cold-press | Commercial Feed millers |
|  | Frass | 0.4 | Pelletized or composted | Farm Fertilizer companies |

*Price collected as of July 2025*

# KEY CHALLENGES

## In BSF Production

### Limited professional skills and technical know-how for farming

Most traditional BSF farming relies on experience-based practices, which may lack consistency and struggle to implement optimized protocols

Environmental factors like temperature and humidity are critical for successful larvae development, but they are often difficult to maintain in stable conditions in traditional farming systems

Larvae are particularly sensitive to environmental conditions, and heat stress during hot seasons and high humidity during rainy periods can negatively affect their growth and development, resulting in impaired mating and egg-laying. The mortality rate at some traditional farms can exceed 15–20% per harvest

The lack of professional knowledge in genetics, nutrition, and environmental management further exacerbates this issue, as farmers may struggle to adopt best practices, leading to inefficient production and higher losses

### Securing certified feedstock supply for exports into premium markets

As organic waste streams become increasingly in demand from sectors such as biogas, composting, and animal feed manufacturers, challenges persist in securing a consistent supply of high-quality, certified feedstocks for BSF rearing, while also complying with export requirement on feedstock's origin, particularly in developed markets such as EU and the US

### Lack of technology adaptation in advanced equipment and machines

Traditional BSF farmers still rely on simple equipment or improvised solutions to meet their specific needs

Some BSF farms use their own assembled larvae-frass separator machines (often cobbled together from simple vibrating motor, cages, or mesh tray), which leads to inconsistent results in the separation process

Similarly, instead of using specialized larvae dryers of heat-convection, farms employ fruit dryer machines which are not optimized for the delicate needs of BSF larvae

The limitations of standardized equipment results in variations in output quality such as uneven drying, contamination risks, and impaired larvae health etc. which ultimately hinders consistency in production

Without the adoption of advanced, purpose-built machinery, traditional BSF production will continue to face difficulties in scaling, improving consistency, and meeting the quality standards necessary for large-scale commercialization

# KEY CHALLENGES

## In BSF Production

### Intense competition leads to insufficient demand for upscaling

Intense competition from traditional feed ingredients like soybean meal and fishmeal is a major reason for the insufficient demand for BSF products

BSF protein meal, priced at 3,500 USD/MT is substantially more expensive than conventional feed ingredients

This cost disparity presents a significant economic barrier for BSF, especially in low-margin sectors like swine and poultry feed. Furthermore, soybean and fishmeal are well-established, widely available, and produced at a massive scale, making them the default choices for many feed manufacturers

The slow adoption hinders production scale and supply, creating a cycle of insufficient demand and make it difficult to achieve economies of scale

Without significant cost reductions and increased supply, BSF remains struggle for market penetration, preventing BSF from fully capitalizing on their potential benefits

### Need for skilled expertise consultancy & educational human resources

Processing BSF into value-added products like protein meal and oil requires specialized expertise in entomology, nutrition, feed formulation, and food safety. However, skilled professionals in these fields are scarce and expensive, which drives up operational costs

Without this crucial expertise, producers struggle to optimize production, ensure product consistency, and meet regulatory standards. This lack of specialized knowledge ultimately hinders both innovation and the ability to scale operations efficiently

### High capital investment & Operational costs

Transitioning from small-scale to industrial BSF production demands substantial capital investment

Setting up a climate-controlled BSF facility, complete with rearing containers and precise temperature, humidity, and aeration systems, is crucial for consistent larvae performance. However, the initial investment for a single pilot module can cost between 10,000 - 15,000 USD. The investment is difficult for many to access without sufficient and stable market demand for their output

In addition, feedstock remains the dominant operating cost, as even "free" organic waste incurs significant hidden expenses for collection, transport, storage, sorting, and preprocessing

# MARKET TRENDS TOWARD SUSTAINABLE FEED ALTERNATIVES

Kingdom of the Netherlands

## Global trends

The global animal nutrition industry is undergoing a major transformation, driven by the growing emphasis and pressure on sustainability in sourcing as well as product development. Traditional feed ingredients such as fishmeal and soybean meal are increasingly scrutinized due to their environmental impact, price volatility, and supply chain risks

In response, the sector led by global animal nutrition companies is gradually shifting focus toward sustainable feed alternatives, piloting sustainable solutions while maintain resource efficiency and supporting animal health.

Among these alternatives, BSF protein is gaining traction as a viable solution supported by evolving regulations, circular economy initiatives, and growing demand from commercial feed producers and niche markets such as pet food

Notable global trends include:

- **Shift away from fishmeal and soy**

Rising environmental concerns (deforestation, overfishing), price volatility, and import dependency are driving the search for alternatives to fishmeal and soy, particularly in aquaculture and poultry feed

- **Rise of circular and waste-based inputs**

Feed ingredients that convert organic waste into high-value proteins, such as BSF, algae, and single-cell proteins, are increasingly being adopted. This approach aligns with circular economy goals and resource efficiency

- **Regulatory opening for insect protein**

Insects, including BSF, are being gradually approved for various feed applications, first in aquaculture and poultry, with pet food and swine feed also gaining regulatory acceptance, particularly in the EU and parts of Asia

- **Demand for low-carbon, traceable feed**

Feed buyers and retailers are incorporating sustainability metrics such as carbon footprint and traceability into procurement decisions. This trend favors novel proteins with transparent, localized supply chains

- **Growth in pet and premium markets**

Sustainable and hypoallergenic ingredients such as BSF are rapidly entering the pet food sector, driven by consumer demand for natural, ethical, and allergen-free products

Additionally, growing awareness that BSF ingredients improve animal gut health is encouraging pet owners to choose these alternatives

- **Market maturation**

While insects remain a relatively new nutrition category, they are becoming widely adopted in pet food markets and gaining traction in aquaculture and livestock segments as consistent usage builds confidence

# MARKET TRENDS TOWARD SUSTAINABLE FEED ALTERNATIVES

Kingdom of the Netherlands

## Local trends

Among sustainable insect-based meals such as mealworm or cricket, BSF larvae are gaining high popularity thanks to abundant availability and highly accessible particularly in Vietnam

Vietnam-specific trends include

- **Government support for circular agriculture**

Vietnamese MOAE promotes circular and low-emission agriculture

BSF aligns with this strategy by transforming food and agricultural waste into animal feed

- **Feed import dependency & price sensitivity**

The feed sector still imports a majority of its soymeal and fishmeal, making the local feed sector vulnerable to global price volatility

Locally produced alternatives such as BSF are gaining attention for their potential to reduce this dependency

- **Shift towards sustainable feed initiatives**

Sustainable feed initiatives are currently underway in Vietnam, primarily driven by international feed companies

In 2023, De Heus introduced F3-Tom, a "fish-free feed" for shrimp using Entobel's H-Meal insect protein to replace fishmeal. This initiative is part of De Heus's broader sustainability strategy and is based on previous joint trials conducted by their Aquaculture R&D team and Entobel in 2022

Additionally, in June-July 2025, several feed companies, including Skretting, Nutreco, Grobest, Green Feed, and CP, achieved ASC Feed Standard for their aqua feedmills in Vietnam. The certification, valid for 3 years, highlights compliance with one of the most rigorous global benchmarks for responsibly produced aquafeed

- **Emerging pet food industry**

Vietnam's domestic pet food market is expanding, particularly in urban areas. BSF is increasingly being explored by startups as a hypoallergenic, sustainable ingredient for premium and export-oriented pet food products

- **Rising local demand among smallholder farms**

Traditionally feeding mealworm into self-mixed feed for swine and chicken, smallholder farms have increasingly adopted BSF products mostly under dried ones into various local species farming

# BSF DEMAND

## Current context

In line with its significant nutritional advantages and global market trends, BSF protein meal has become a prominent and sustainable alternative protein source in animal feed at global scale. In 2025, market size of BSF meal globally is estimated at 20-25 KMT

In less than a decade of development in Vietnam, BSF meal has gained popularity thanks to its wide application across local smallholder farms and among large-scale feed millers. With respect to average annual demand, Vietnamese BSF market is estimated about 360 MT of BSF dried larvae, mostly by smallholders and around 4 KMT of BSF meal for feed millers

BSF meal also yield high potential for exports. High quality BSF meal products have exported to developed markets including South Korea, Japan, Australia, USA and potentially to EU

BSF products remain positive perspective among local smallholders, as a substitute replacement of commercial feed and additional ingredients in their home-mixed feed often comprising of agricultural by-products such as rice bran, cassava, sweet potato..., overall reducing their dependency on volatile feed prices while upcycle organic wastes

Rather than BSF meal, small-scale farms primarily use fresh larvae or basic processed products such as dried or frozen larvae for economy purpose, making BSF become practical option for improving animal diets

Demand for BSF larvae is thus growing in Vietnam in the recent years particularly among poultry, frog, and tilapia small-scale farms, driven by interest in natural feed alternatives from BSF's proven nutritious values

Perceiving BSF larvae as naturally nutritious feed source which could improve health and growth, BSF practices fed to swine, poultry and aqua species are applied in the same traditional manner of mealworms among smallholders with back-yard and extensive farming

Common belief that fresh products are more nutritious and high palatability than processed ones, fresh BSF larvae is often boiled then fed directly to chickens, as well as to fish

Alternatively, BSF larvae is combined with home-mixed feed ingredients and commercial feed, typically constituting of 10% and gradually increase to 20-30% of BSF larvae based on farmers' experiences to create balanced mixture

Fresh BSF larvae are favored and feasible by farms located within approx. 10 km of BSF rearing sites due to ease of transport, while farms located further away opt for frozen or dried forms for their longer shelf life and ease of storage

As BSF larvae farms are clustered in the Southeast and MRD region, fresh larvae are typically popular among smallholders in Dong Nai, HCMC or Tien Giang and Long An

Dried larvae on the order hand can serve for broader market reach countrywide. Farms in the central and northern region often purchase from BSF larvae suppliers in central cluster, notably Gia Lai province

Distribution channels range from direct farm-to-farm transactions and even through online local e-commerce platforms. Delivery often takes within one to three days

# CURRENT PRACTICES

## Smallholder farms

Vietnamese smallholder farmers have traditionally incorporated superworm and mealworm into their home-mixed livestock and aquaculture feeds. In similar manner, BSF larvae serve as a nutrient-rich supplement that supports animal health, growth, and final product quality

### Aquaculture

In the Tien Giang and Long An provinces, freshwater fish farms add fresh and dried BSF larvae directly into the diets of common species such as tilapia, red tilapia, barramundi, snakehead, and catfish. BSF is used either as a nutritional supplement or substitute for commercial feed

Some shrimp farms have tried partially mixing commercial feed with BSF larvae and observed positive outcomes, as the shrimp readily consumed the larvae

However, the production cycle was noted to be longer by approximately 10 days compared to using only standard commercial feed

### Swine

Fresh BSF larvae are integrated into a mix of fermented distiller's grain by-product and conventional feed

### Poultry

Broiler chicken farms adopt BSF larvae as partial replacement feed, feeding it to chickens in fresh, dried, or frozen forms

Currently BSF are not fed to ducks

### Others

A mix of fresh and frozen BSF larvae can completely replace commercial feed for frogs and certain local snail species, such as apple and sweet snails, which are commonly found in coastal regions Ninh Thuan and Cam Ranh

| SMALLHOLDER FARMS | Swine | Chicken | Duck | Freshwater fish | Vannamei shrimp | Frog | Freshwater Snail |
|---|---|---|---|---|---|---|---|
| Fresh larvae | ✓ | ✓ | ✗ | ✓ | ✓ | ✓ | ✓ |
| Primary processed (Dried/Frozen larvae) | | | | | | | |
| Value-added processed (Protein meal, oil..) | ✗ | ✓ | ✗ | ✗ | ✓ | ✗ | ✗ |

*Source: Compilation from fieldwork*

# CURRENT PRACTICES

## Commercial feed producers

Global feed millers have shifted focus on adopting low-emission raw materials that protect the environment while conserving natural resources. In this context, BSF larvae and their derivatives have emerged as promising substitutes for conventional, high-impact ingredients like fishmeal for the commercial feed industry. This momentum is reinforced by a combination of evolving local regulations, increasing demand from commercial feed millers, and emerging markets like pet food.

BSF larvae is a valuable substitute for fishmeal and widely recognized among feed millers as a sustainable, high-protein source and functional benefits with essential amino acids. Key value-added products, including BSF larvae meal and larvae oil are gaining traction in the feed sector

Feed millers are generally open to sustainable alternative solutions however, adoption into formulations remains hesitant, primarily concerning on BSF's nutritional consistency, supply reliability and respective substitute cost

Ongoing R&D efforts contribute to increase replacement rate of BSF meal to conventional ingredients. The current replacement rate of high quality BSF meal to fishmeal reaches 1:0.6 ratio on a protein-equivalent basis and expect to achieve higher at 1:1 ratio. Nevertheless, there is existing replacement hurdle rate in place on optimal percentage replacement of BSF meal for fishmeal, particularly for shrimp feed for optimal output growth. Replacement hurdle rate ranging from 10-20% are mentioned in multiple studies for respective species

Cost remains a major hurdle preventing feed millers from integrating BSF's products into commercial feedlines at the moment, indicating that replacing BSF larvae meal is significantly more expensive than conventional ingredients such as fishmeal, soybean meal or locally-supplied bone meal and blood meal

Today BSF larvae meal is offered at around 3,500 USD/MT, which appears considerably expensive in comparison of those of traditional feed ingredients. Cost concern shall also limit BSF meal integration into feed species with thin margin or among feed producers with low bargaining purchase power

Although from current perspective that BSF larvae meal has a low likelihood of replacing fishmeal in terms of economic competitiveness, feed companies have continued to implement study and trials for partially replacing fishmeal with BSF derived products feasibility study while maintain wait-and-see status

Leading animal feed companies such as De Heus and Vinh Hoan have already integrated BSF larvae meal and oil into their commercial feed lines, notably in swine feed for piglet, chicken broiler and aquafeed, proving confidence in BSF's scalability and its alignment with corporate sustainability commitments

| Feed products | | Average % Fishmeal in feed use | Average Retail price (USD/MT) |
|---|---|---|---|
|  | Pig 15–25 kg | 5 | 600 |
| | Pig 20–50 kg | 3 | 550 |
| | Pig >50 kg | 2.5 | 520 |
|  | Broiler 1–60 days old | 10 | 500 |
| | Broiler 61–150 days old | 8 | 450 |
| | Layer | 10 | 400 |
|  | Vannamei Shrimp (1–5g) | 30 | 1,500 |
| | Pangasius (>200g) | 8 | 500 |
| | Tilapia (>100g) | 10 | 760 |

*Fishmeal of 50-60% protein content*

*Source: Compilation from desk research and fieldwork. Price collected as of July 2025*

# COMPARATIVE ANALYSIS

Kingdom of the Netherlands

## Advantages versus conventional feed ingredients

**BSF meal contains higher nutritional value and functional benefits**

Dried BSF larvae contains 40–44% crude protein with an amino acid profile comparable to fishmeal, and are notably rich in lysine, methionine, and threonine. In addition, BSF larvae are lipid-rich, containing 30–36% fat with high proportion of medium-chain fatty acids such as lauric acid, which is known for its antimicrobial properties and for providing an energy-dense feed component

Comparing to fishmeal, BSF protein meal offers a highly compatible alternative with strong nutritional, functional, and sustainability advantages. Defatted BSF meal typically contains 50–65% protein, closely matching fishmeal's 60–72%, with amino acid patterns—particularly lysine, methionine, and threonine—well suited to the needs of carnivorous fish and shrimp

Although BSF meal has lower methionine than fishmeal, it is richer in other essentials like histidine, threonine, and tryptophan. These support osmoregulation, adaptation, mucus formation under stress, and stress reduction for animals via synthesis of serotonin

Highly digestible and free from plant-based anti-nutritional factors, BSF meal supports easy formulation and, when used as partial replacement, can maintain growth, feed efficiency, survival, and even boost immunity in key species

In addition to the protein meal, BSF oil—naturally rich in lauric acid, a potent antimicrobial medium-chain fatty acid (about 21 g/kg of fat versus virtually none in fishmeal)—is emerging as one of the most promising innovations in high-value functional ingredient, now proven to deliver tangible performance benefits in early-stage piglet diets. Early trials with small dietary inclusions have already demonstrated notable gains in average daily weight gain and feed efficiency, without compromising health indicators, highlighting its strong potential for wider adoption

Nutritive value, amino acid & lauric acid profile in BSF vs Fishmeal

| Nutrient- | BSFL | FM |
|---|---|---|
| | g/1000 g of dry matter | |
| Crude protein | 350 | 618 |
| Crude fat | 298 | 165 |
| Crude fibre | 79.0 | 0 |
| Crude ash | 53.0 | 175 |
| Nitrogen free extract | 221 | 42.0 |
| Amino acid | g/100 g of crude protein | |
| Aspartic acid | 7.30 | 9.40 |
| Glutamic acid | 13.1 | 14.5 |
| Serine | 4.88 | 4.17 |
| Glycine | 6.15 | 6.41 |
| Histidine | 3.25 | 2.09 |
| Arginine | 5.47 | 6.07 |
| Threonine | 4.43 | 4.10 |
| Alanine | 8.21 | 6.87 |
| Proline | 6.68 | 4.28 |
| Tyrosine | 6.71 | 3.00 |
| Valine | 6.79 | 5.79 |
| Methionine | 2.12 | 2.53 |
| Cystine | 0.76 | 9.59 |
| Isoleucine | 4.73 | 4.24 |
| Leucine | 7.83 | 7.48 |
| Phenylalanine | 7.76 | 3.07 |
| Lysine | 6.82 | 6.63 |

| Fatty Acid | BSFL | FM |
|---|---|---|
| | g/100 g of crude fat | |
| C12:0 (lauric acid) | 21.00 | <0.1 |
| C13:0 (tridecylic acid) | <0.1 | <0.1 |
| C14:0 (myristic acid) | 3.70 | 5.30 |
| C15:0 (pentadecanoic acid) | <0.1 | 1.10 |
| C16:0 (palmitic acid) | 5.30 | 5.30 |
| C17:0 (margaric acid) | <0.1 | 1.40 |
| C18:0 (stearic acid) | 0.80 | 4.40 |
| C20:0 (arachidic acid) | <0.1 | 0.20 |
| C21:0 (heneicosanoic acid) | <0.1 | 0.20 |
| C22:0 (behenic acid) | <0.1 | 0.20 |
| C23:0 (tricosylic acid) | <0.1 | 0.10 |
| C24:0 (lignoceric acid) | <0.1 | 0.20 |
| C14:1 (myristoleic acid) | <0.1 | 0.20 |
| C15:1 (ginkgolic acid) | <0.1 | <0.1 |
| C16:1 n7 (palmitoleic acid) | 1.60 | 5.30 |
| C17:1 (margaroleic acid) | <0.1 | <0.1 |
| C18:1 n9 (trans-elaidic acid) | <0.1 | 0.20 |
| C18:1 n9 (oleic acid) | 6.10 | 13.00 |
| C18:1 n7 (vaccenic acid) | 0.20 | <0.1 |
| C20:1 n9 (eicosenoic acid) | 0.10 | 1.50 |
| C22:1 n11 (gadoleic acid) | <0.1 | <0.1 |
| C22:1 n9 (erucic acid) | <0.1 | 0.20 |
| C24:1 n9 (nervonic acid) | <0.1 | <0.1 |
| C16:2 n4 (hexadecadienoic acid) | <0.1 | <.01 |
| C16:3 n4 (hexadecatrienoic acid) | <0.1 | <0.1 |
| C18:2 n6 (trans-linolelaidic acid) | <0.1 | 0.20 |
| C18:2 n6 (linoleic acid) | 3.80 | 1.70 |

*Source: Rawski et al., 2020*

# COMPARATIVE ANALYSIS

Kingdom of the Netherlands

## Advantages versus conventional feed ingredients

### Insect meal as an environmental sustainability alternative in farming

Insect farming, with BSF included, offers environmental advantages over traditional protein sources such as soybean meal and fishmeal. Replacing fishmeal with BSF in feed formulations enable more sustainable pathway reducing pressure on natural marine resources since it takes about 4kg of wild-caught fish to produce 1kg of fishmeal

Unlike soy cultivation—which drives land conversion, heavy irrigation, and agrochemical runoff—or wild fish harvesting, which depletes marine stocks and disrupts ecosystems, BSF farming requires minimal land and water. Facilities can operate on marginal or non-arable land, avoiding deforestation, habitat loss, and over-extraction of aquatic resources. It also avoids the effluent discharge typical of fishmeal production and uses little to no pesticides or fertilizers of soybean meal

BSF excel at converting organic waste into high-quality protein and frass, a nutrient-rich fertilizer. This process diverts food waste from landfills, reduces methane emissions, and promotes nutrient recycling. Under optimized conditions, BSF composting can achieve net-negative emissions (–24.8 kg $CO_2$ eq per ton of waste) and cut carbon emissions by up to 79% per kilogram of larvae compared with standard waste-to-protein systems

In aquaculture where feed production accounts for 80–90% of both costs and GHG emissions, BSF meal offers a highly efficient feed-to-biomass conversion rate, requiring less space and fewer resources than conventional production. While processing energy can make BSF meal's GHG footprint higher than soy or fishmeal in some cases, advances in automation and renewable energy integration are expected to strengthen its climate and resource efficiency

BSF farming presents a scalable and sustainable protein solution poised to reduce reliance on resource-intensive, carbon-heavy livestock systems, offering a practical and near-term pathway toward more resilient, circular, and climate-smart food production

Environmental impact of insect farming relative to soy and fishmeal production

| ENVIRONMENTAL IMPACT | | SOYBEAN MEAL | FISHMEAL | INSECT MEAL |
|---|---|---|---|---|
| **State indicators (i.e. changes to the state of nature)** | | | | |
| Land use change | | High conversion risk | No impact | No land use change at scale |
| Soil condition | | Intensive agriculture | No impact | No impact |
| Climate impact | | Conversion | Relatively low emissions from shipping | Operation of facility |
| Water removed | | If irrigated | Low impact | Operation of facility and substrate moisture adaptation |
| Nitrogen | | If NPK applied to soy or to crops in rotation | No impact | Nitrogen accumulation in frass |
| Biodiversity | | Conversion and intensive agriculture | Reduced fish stocks, by-catch | Low ecological impact |
| Pollution | | Pesticide use and eutrophication | Effluent discharge | Limited evidence |
| Waste | | Limited evidence | Limited evidence | By-products chitin and frass have uses |
| **Pressure indicators (i.e. environmental footprint assessments)** | | | | |
| Land use footprint | | Large area required | Small area used | Small area used |
| Carbon footprint | Direct | Cultivation and shipping | Fishing vessels | Heating requirement |
| | Indirect | Land use change | Low indirect footprint | Substrate dependent |
| Water footprint | | High water use | Limited evidence | Low water use |

■ high impact; ■ moderate impact; ■ low impact; blank for negligible or unknown impact

*Source: WWF The Future of Feed*

# COMPARATIVE ANALYSIS

## Challenges versus conventional feed ingredients

### Abundant supply of fishmeal from local sources

Although about 40% of fishmeal are sourced from imports, it comprises mostly high-protein products with above 50% protein content from US and EU while 60% of demand is supplied locally

Besides wild-caught source, fishmeal derived from aqua-processing by-products, is abundant in Vietnam due to its extensive seafood processing and export infrastructure, especially in the southern regions near major aquaculture hubs. Currently, the country widely available domestically, sourced from local processing facilities. They boasts approximately 620 industrial-scale seafood processing facilities alongside 3,000 small-scale operations, producing a total fishery output of about 9 MN MT per year. This scale and consistency make fishmeal a reliable and cost-effective protein source widely used by feed millers

Other protein alternatives sources other than fishmeal such as meat or bone meal and blood meal are also among the cheapest protein options, making them attractive in cost-sensitive feed sectors despite their comparatively lower nutritional value and palatability

Soybean meal plays an even more pivotal role in the feed industry, with Vietnam among the world's top importers and volumes projected to reach 6 MN MT by 2025. It accounts for 15–35% of feed ingredients across both aquatic and livestock feed formulations, supported by a massive, stable, and competitively priced supply. This high-volume usage makes soybean meal virtually irreplaceable in mainstream feed production, despite being largely imported

BSF meal is still in the early stages of commercial scale-up in Vietnam. Production volumes are far smaller than for fishmeal or soymeal, and the supply chain for BSF remains underdeveloped, limiting its availability for large-scale feed applications. Until production capacity, farming infrastructure, and distribution networks expand, BSF meal might face challenges meeting the volume requirements of major feed millers

### BSF high cost remains a challenge for large-scale adoption

Even though BSF brings added advantages of high digestibility, strong palatability, complete amino acid profiles, antimicrobial lipids and sustainability benefits, its current price remains a key challenge for commercial feed large-scale adoption, particularly in thin-margin category like swine and poultry

High-protein BSF larvae meal currently sells for about 3,500 USD/MT, compared to fishmeal at roughly 1,650 USD/MT and soybean meal at just 500 USD/MT

The country also has abundant low-cost protein alternative inputs sourced from various types of processing facilities across the country, such as blood meal and bone meal are also generally more affordable at about 1,000 USD/MT and 300 USD/MT, respectively

Currently ratio replacement rate of BSF meal to fishmeal reaches 1:0.6 ratio on a protein-equivalent basis although ongoing R&D effort is steadily developed by achieving 1:1 ratio

Higher optimal hurdle rate would enable further closing both functional and economic gaps of BSF protein against fishmeal while delivering higher nutritional and sustainability value

*Price collected as of July 2025*

# KEY CHALLENGES

## BSF meal in commercial feed adoption

### Nutrient variability

The variability of BSF's nutrient composition, which is influenced by its rearing substrate, poses challenge to commercial feed sector's demand for quality consistency

Achieving this consistency is contingent upon the implementation of standardized production protocols and effective, rapid quality testing

### Inadequate economic competitiveness

BSF meal remains significantly more expensive than conventional feed ingredients such as soymeal or fishmeal. This cost disparity limits its attractiveness in mainstream commercial feed markets

Given that feed margins are typically low, especially in the aquaculture and poultry sectors, feed manufacturers will naturally prioritize the most cost-efficient ingredients to maintain profitability. Therefore, BSF suppliers often struggle to secure long-term off-take agreements, especially at larger scale

### Fragmented production

Traditional BSF farming is predominantly characterized by small and simple operations. Many community-based projects lack the foundational elements of a commercial model, such as strategic business planning and integration into established feed supply chains

Achieving the scale necessary for consistent supply to large feed millers shall require significant investment in capital, infrastructure, and technical expertise

### Regulatory uncertainty

While regulations are improving, BSF use in feed is not yet universally accepted across all species or markets, creating uncertainty for producers and exporters

A key issue is the lack of harmonized global regulations on what can be used as BSF feedstock. The final products—such as protein meal, oil, and frass, also require specific approval for various applications, which also varies by market

### Market familiarity & acceptance

Many feed manufacturers and farmers are still unfamiliar with BSF or hesitant to adopt it, considering farming is highly risk-averse, as even minor changes in feed composition can affect growth, survival, and disease resistance

The cautious approach is a result of the limited and often inconsistent research on BSF's applications in feed

Concerted efforts in targeted education, practical trials, and performance validation would be essential

### Optimal replacement hurdle rate

An existing hurdle for feed millers is the replacement rate for BSF meal. Several studies mentioned to maintain optimal results, BSF meal can only replace a limited portion of fishmeal—typically 10-20% for different species. This continue to hinder broader integration of BSF meal into commercial feed formulations

# EXPORT CONDITIONS

## BSF Meal by destination markets

The EU leads the way in regulatory acceptance and market development for using insect protein in animal feed

Countries of Germany, the Netherlands, France, and the UK are major players in both producing and consuming these products

A key turning point was the EU's 2017 approval (Regulation 2017/893), which allowed processed insect protein (insect PAPs) in aquaculture feed in which authorized species include BSF

This made aquafeed an increasingly important market. This approval was later expanded in 2021 to include feed for poultry and pigs, further broadening the market for insect PAPs

Meanwhile US has a distinct and evolving regulatory framework for the use of insects in animal feed, primarily governed by the Food and Drug Administration (FDA) and the Association of American Feed Control Officials (AAFCO)

The regulatory is based on a case-by-case review process through the FDA's "no objection letter" which gradually allow insect-derived products into feed

**Regulatory possibilities for insect feedstock**

| Feedstock sources | | |
|---|---|---|
| Vegetable substrates | ✓ | ✓ |
| Unprocessed former food waste, Dairy & eggs | ✓ | ✓ |
| Unprocessed former food waste, Meat & fish | ✗ | ✗ |
| Catering waste & slaughterhouse products | ✗ | ✗ |
| Animal manure | ✗ | ✗ |

**Regulatory possibilities for insect applications**

| Target species | Meal Protein | | Oil Fat | | Live larvae | | Dried/ frozen | |
|---|---|---|---|---|---|---|---|---|
| Pet food | ✓ | ✓ | ✓ | ✓ | ✓ | - | ✓ | - |
| Aquafeed | ✓ | ✓ | ✓ | ✓ | ✓ | - | ✗ | ✓ |
| Poultry | ✓ | ✓ | ✓ | ✓ | ✓ | - | ✗ | - |
| Swine | ✓ | ✓ | ✓ | ✓ | ✓ | - | ✗ | - |
| Ruminant | ✗ | - | ✓ | - | ✗ | - | ✗ | - |

*Source: IPIFF 2022*

# CERTIFICATIONS

## Eligibility requirements for BSF

| |  |  |  |
|---|---|---|---|
| **Product classification** | Food (for human consumption) → Novel Food under Reg. 2015/2283<br>Feed / PAP (animal feed, aquaculture, pet food) → under Reg. 1069/2009 & 142/2011 | Animal Food (animal feed, pet food, ingredients) → regulated by FDA-CVM<br>PAP from insects → if of animal origin, APHIS permit required | Food → regulated under Food Sanitation Act<br>Animal Feed → regulated by MAFF, may require permit/quarantine<br>Live insect → Plant Quarantine Law |
| **Approved ingredients** | Only permitted substrates allowed<br>Ingredients/additives must be listed in the EU feed catalogue | Must be Food Additive (21 CFR 573), GRAS (21 CFR 582), or listed in AAFCO<br>GRAS for humans does not auto apply to animals | Only ingredients allowed under Japanese law<br>Prohibited/restricted harmful substances; tested per MHLW/CAA standards |
| **Facility registration / Approval** | Processing facilities must be registered/approved with EU authority<br>Food: Novel Food authorization<br>Feed/PAP: approval under Reg. 1069/2009 | Facility must be registered with FDA<br>Prior Notice required for each shipment<br>If PAP from animal origin → APHIS permit | Importers must register with CAA/MHLW<br>Products with animal origin may require MAFF quarantine. |
| **Food safety system** | HACCP per Reg. 852/2004 & 183/2005<br>GMP, GHP; traceability (one step back/forward) | HACCP/Food Safety Plan per FSMA<br>Importers must comply with FSVP<br>Optional VQIP for expedited entry | HACCP/food safety control<br>Import inspection at port of entry |
| **Certificates with shipment** | Health certificate (for PAP/animal origin feed)<br>Certificate of Origin (CO), lab reports (microbiology, heavy metals, etc.) | Health certificate (if PAP, as per APHIS)<br>CO, test reports<br>FSVP documentation (if required). | Health certificate (if required)<br>CO, test reports<br>Plant quarantine certificate (if live insect) |
| **Labelling requirements** | Food: per Reg. 1169/2011<br>Feed: per Reg. 767/2009. | Animal food: per 21 CFR Part 501<br>No misbranding/mislabeling | Japanese label shows ingredients, production date, BBD, manufacturer/importer |
| **Port inspection** | Document check and possible sampling (RASFF alerts for violations) | FDA inspection; may detain or refuse shipment if non-compliant | Document check, sampling/testing; may require additional lab tests |

# MARKET OPPORTUNITIES

Kingdom of the Netherlands

## High-quality breeding stock & genetics for BSF

While the sector is thriving, it is largely been built on local, unoptimized strains. As the sector matures, a shift towards industrialization and profitability will drive the need for genetically superior BSF lines

A top priority is supplying superior BSF breeding stock with genetics proven to deliver faster larval growth, higher protein conversion, and better adaptation to Vietnam's tropical climate and local substrates (e.g., rice bran, agricultural by-products)

Since only few farms currently specialize in BSF breeding, and most are smallholder operations, there is a significant need for specialized consulting to help farms establish and effectively manage their own breeding programs

Active companies/organizations:

- Vietnam National University of Agriculture conducted study on the genetic diversity of BSF populations across Vietnam
- The Netherlands leads in insect genetics and microbiome optimization. Collaborations like Hendrix Genetics with Protix can be adapted to Vietnam, supporting strain development, genetic IP commercialization, and licensing

## Automated rearing systems & equipment

Vietnam's tropical climate is generally favorable, but temperature and humidity fluctuations can impact BSF larvae growth and reproduction. Hence, there is potential for modular, climate-controlled BSF production systems. These solutions shall feature automated feeding, efficient drying and processing, and mechanized harvesting which designed to maintain optimal conditions for BSF

Manual BSF farming is labor-intensive, and yields can be inconsistent. Automation can address this with standardized processes

Active companies/organizations:

- Finom, the partner in the construction of Entobel's facility. Finom provides designing and constructing the greenhouses, misting and automatic controlling systems with controllers that track environmental data
- Adaptation of proven agri-tech (e.g., greenhouse, poultry, and horticulture systems) to vertical insect farming. Companies like Amusca and Insect Engineers already pilot such solutions

# MARKET OPPORTUNITIES

Kingdom of the Netherlands

## Circular business model integration

Vietnam's large agricultural sector and rapid urbanization generate massive amounts of organic waste from food processing and farms

The government is actively promoting a circular economy. Recent national master plans and decisions have outlined a direction to prioritize waste sorting, minimize landfills, and transition to modern, sustainable waste treatment technologies. This top-down policy support creates a favorable environment for BSF-based solutions

The BSF-based solutions would further provide a profitable alternative to traditional waste disposal. This creates a dual-benefit model: businesses pay for a sustainable waste management service and get a share of the value created from the BSF products

Specialized consulting is also encouraged to help companies optimize the process, ensuring reliable BSF output year-round from varied waste sources

Active companies/organizations:

- Green Connect Larva Yum a social enterprise specialize in treat and upcycle organic. Green Connect partners with Mondelez Kinh Do, support the facility in Binh Duong convert its food waste into animal feed
- Green Connect farms BSF and use as feed source for their own "3 Mộc" brand of free-range chickens and "3 Mộc" eggs
- Entobel partners with Heineken Vietnam
- Other companies with strong track record in circular economy and public-private partnerships, similar to the model of Protix-Skretting-Albert Heijn consortium in Ecuador

## Bioconversion optimization consulting

Provide specialized consulting services to optimize BSF production by analyzing local organic waste composition, developing substrate preparation protocols, and designing nutrient supplementation strategies

Partnerships can be considered with Dutch companies specialize in waste valorization, feed formulation, and feedstock preprocessing technologies

This expertise helps Vietnamese producers achieve consistent larval growth rates and protein yields despite the seasonal and compositional variations in available waste streams

## Pet food ingredients

BSF protein and oil profile, as well as the functional benefits of BSF to produce healthier, less destructive ingredient sources as for the preparation of pet food

With the growing demand for eco-friendly pet food, BSF has strong export potential, especially in markets like EU and US.

Domestically, rising pet ownership among Vietnam's urban middle class is fueling a demand for premium, high-protein pet food. The market, estimated at 6.5 MN dogs and 5.6 MN cats, is growing by 9-10% annually and seeing significant expansion in the premium segment

Active companies/organizations:

- Truoo Pet Care, a De Heus owned company, presence in Vietnam enables strategic BSF supplier partnerships. Also, Vietnamese market can be potential for other Dutch petfood companies as Vobra Special Petfoods and Prins Petfood

# MARKET OPPORTUNITIES

Kingdom of the Netherlands

## Soil amendment

BSF larvae frass is nutrient-rich, containing notable concentrations of nitrogen (N), phosphorus (P), potassium (K), organic matter, and beneficial micronutrients. These are crucial for crop growth and help replenish soil fertility naturally. It acts as an effective soil amendment, enhancing soil structure that help farmers reduce dependence on costly synthetic fertilizers

Vietnam's large agricultural sector creates a huge demand for fertilizers, especially as the government actively promotes sustainable and organic farming. The rising costs of imported chemical fertilizers and the growing awareness of soil degradation create a strong market pull for effective, local, and sustainable alternatives like BSF frass

Currently, frass is mostly sold in 20 kg bag by traditional farms at 0.4 USD per kilogram to some nearby cultivation farms. Some fertilizer companies' contract with BSF farm to purchase BSF frass for their fertilizer manufacturing, selling to organic horticulture and fruit farms at higher prices

Active companies/organizations:

- Entobel's H-Ferti, a multi-functional soil amendment consisting of non-digested organic substrate and larvae frass
- BSF organic fertilizers from local players Huy Tam Farm, An Dong Feed, Kimmy Farm

## Pharmaceuticals, agri-tech, and cosmetics ingredients

BSF chitosan is made from the shells or skins of its larvae. These parts are treated then processed with chemicals to turn chitin into chitosan

Chitosan is a biomaterial with anti-microbial, moisturizing, and anti-inflammatory properties

BSF chitosan is considered to be superior to traditional crustacean chitosan for its sustainability, traceability, and undetectable toxic heavy metals

Active companies/organizations:

- Insectta, a Singapore-based biotech company that specializes in extracting high-value biomaterials from BSF larvae, making it suitable for applications in pharmaceuticals, cosmetics, and personal wellness

## Biodiesel production

BSF prepupae are a promising source of biodiesel, with lipids that meet key international standards like EN 14214

Studies in Vietnam and Taiwan show that BSF-derived biodiesel can reach up to 94% yield and meet European quality standards. In transesterification, BSF oil is converted into biodiesel, with n-hexane proving especially effective in boosting output

Active companies/organizations:

- A growing number of startups in Asia, Europe, and Africa have completed pilot projects proving that BSF-derived oil can be processed into biodiesel

# MARKET OPPORTUNITIES

Kingdom of the Netherlands

## Turn-key BSF insect farming solutions

Vietnam has become a potential hub for large-scale BSF operations since prominent player Entobel have already established highly automated factories in the country. This trend creates a direct opportunity for service providers to offer end-to-end, turn-key solutions for building these industrial-scale facilities

Meanwhile the remaining landscape is still dominated by small-sized traditional farms which demand for modular, "plug-and-play" BSF farming units, such as containerized solutions that can support transition from small-scale to industrial-level production

These turn-key systems include all necessary equipment, training, and ongoing technical support to enable quick market entry without requiring extensive technical expertise from operators

Active companies/organizations:

- Integration of proven technology and IP-backed production systems from Royal Dutch Kusters Engineering, VDL Insect Systems, and Viscon Insect Technology can facilitate rapid deployment and ensure long-term scalability

## Quality control & nutrient analysis

Deploy portable testing equipment and establish laboratory partnerships to provide real-time analysis of BSF larval protein content, amino acid profiles, and fat composition. This addresses the critical challenge where inconsistent nutrient profiles in BSF products undermine aquaculture feed performance and customer confidence, requiring standardized quality assurance systems.

Active companies/organizations:

- Advanced laboratories and agri-tech firms developing on-site rapid diagnostic tools as for example, NIR (Near-Infrared) scanner. Notable suppliers are Nutri-Control and AgroCare

## Training & knowledge transfer

The sector's rapid growth, coupled with a mix of industrial and small-scale producers, creates a diverse need for specialized skills and know-how

The majority of BSF operations in Vietnam are currently small-sized and rely on experience-based practices. These farmers would need segmented, tailored and practical, accessible training, such as hands-on workshops, feedstock management, processing and business skills

On another side, while large-scale BSF farming is a new segment, the use of insects as animal feed is not entirely foreign to Vietnamese culture. Training programs can build on this foundation by providing modern, scientific knowledge and techniques to improve on traditional practices

Active companies/organizations:

- Nong Lam University projects focus on developing farming protocols and partnering with local governments in Dong Nai and Tien Giang to organize training workshops and transfer farming techniques to local farmers
- Aeres University of Applied Sciences, Wageningen University, and private sector players as global leaders in agri-training and curriculum development

# ABBREVIATIONS

| | |
|---|---|
| **AAFCO** | The Association of American Feed Control Officials |
| **BN** | Billion |
| **BSF** | Black Soldier Fly |
| **C/O** | Certificate of Origin |
| **DARD** | Department of Agriculture and Rural Development |
| **EU** | European Union |
| **FCR** | Feed conversion ratios |
| **FDI** | Foreign Direct Investment |
| **GHG** | Greenhouse gas |
| **GMP** | Good Manufacturing Practice |
| **GSO** | General Statistics Office of Vietnam |
| **HACCP** | Hazard Analysis and Critical Control Points |
| **IFC** | The International Finance Corporation |
| **ISO** | International Organization for Standardization |
| **MARD** | Ministry of Agriculture and Rural Development |
| **MN** | Million |
| **MOAE** | Ministry of Agriculture and Environment |
| **MOH** | Ministry of Health |
| **MSG** | Monosodium glutamate |
| **MT** | Metric ton |
| **USD** | US Dollar |
| **VND** | Vietnamese Dong |
| **Y.O.Y** | Year-over-Year |

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