

MARCH 2023

Black Soldier Fly Poised to Take Flight as Leading Alternative Protein Source

Novel proteins derived from insects are gaining traction among investors and entrepreneurs for their attractive environmental and economic business models.

INSIDE THIS ISSUE:



- 01 | Introduction
- 02 | Black Soldier Fly 101
- 03 | Efficient Little Buggers!
- 04 | The BSF Product
- 05 | Industry Barriers
- 06 | The Future of Black Soldier Fly

01

INTRODUCTION

Unlike traditional livestock, insects require less land, water, and feed to grow. They are also a rich source of essential amino acids, vitamins, and minerals and, in some cases, like aquaculture, are a more natural ingredient in diets than vegetable counterparts.

Among insect proteins, those derived from **Black Soldier Flies (BSFs)**, scientifically known as *Hermetia illucens*, are emerging as one of the most interesting among institutional investors. Last year, this point was punctuated by the **USD 250m Series D round in Innovafeed**, one of the largest producers of protein derived from BSF.

The round stood out for its size in a battered venture capital market and for the parties it attracted. Well-known food-focused investors Creadev and Temasek participated, while strategic agri-partners Archer Midland Daniels and Cargill signed up for long-term offtake agreements with the French-based company.

In this issue of Periscope, we've teamed up with **Beta Bugs**, a Scotland-based insect genetics company developing and distributing breeds of Black Soldier Flies for the insect farming community, to elaborate on the industry landscape.



The overall insect protein market is expected to grow to

**USD
8 Billion**

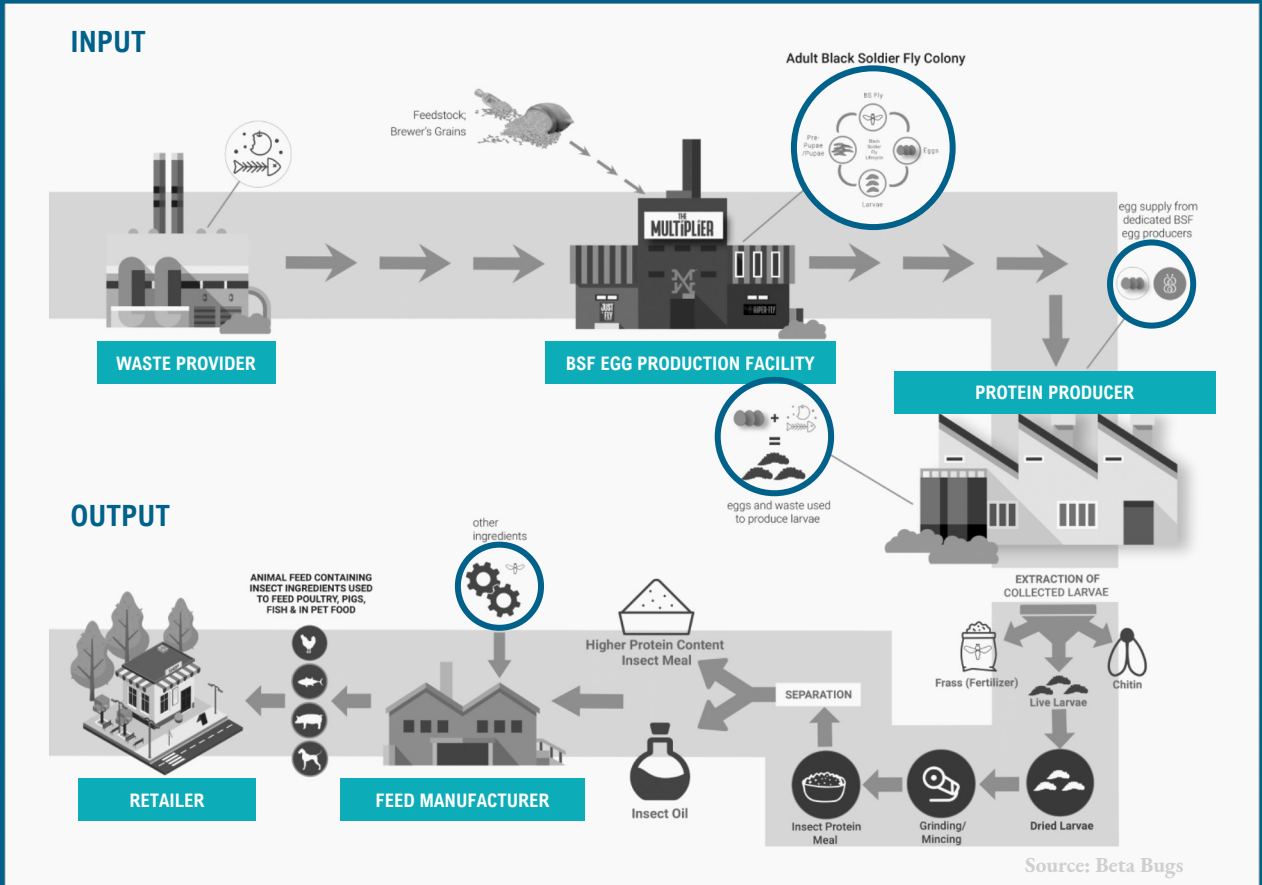
by 2030, per a 2019
Barclays research note.

**Let's explore
what the BSF
buzz is all about.**

02

BSF 101

The concept of insect farming is (theoretically) simple – breed, rear, and harvest insects to process them into end-products for the wider agri/aqua food chain, including feed, pet food, and human nutrition products. The diagram below demonstrates the value chain for BSF.



Similar to other protein production industries, specialization across the value chain is beginning to take shape, an essential milestone in the growth of the space. Companies focused on the grow-out process, full lifecycle, and genetics are forming:

- **Half-life cycle producers** only rear the protein-generating part of the insect. They receive regular batches of eggs and grow them for conversion into protein.
- **Full-life cycle producers** make eggs for in-house production that are hatched and reared to produce insect protein. A small percentage of each generation is raised to adulthood, allowing the production of the next batch of eggs.

Grabbing the attention of sustainability-minded investors is the circularity of BSF business models.

BSF can be fed organic waste from various sources, helping to address a global food waste issue.



Black Soldier Fly and Food Waste

Of course, not all waste will produce the same results. Insect diets must be closely monitored and controlled in line with the compliance standards for animal feed.

The substrate (from which the insect obtains its nourishment) is sourced from registered operators and often prepared to match the dietary requirements of the BSF and its lifecycle.

After the larval stage, BSF leftovers, known as frass, can be used as fertilizing material on nearby agricultural land, further closing the economic loop.



USD 400 Million

per year of food, is wasted from harvest to shelves.



Additional 17%

of food is wasted by the customers after retail purchase.



1.25 Billion

of hungry people could be fed with the discarded food.



8% - 10%

of global greenhouse emissions could be halted if this food is used.

Source: FAO

03

EFFICIENT LITTLE BUGGERS!

Currently, 80 billion animals are reared and slaughtered each year worldwide. Feeding all these animals requires precious resources such as land and water.

In particular, the production of soy, 75% of which is used in animal feed, fuels climate change through deforestation, habitat conversion in critical ecosystems, and the overuse of harsh farm chemicals.


WHAT ABOUT A BSF?

Feed Conversion Ratio (FCR)

The Feed Conversion Ratio (FCR) is another critical measure in the protein industry that weighs how much feed is needed to produce one unit of biomass for the species.

Highly efficient converters generate better margins since feed is typically any protein company's most significant cost component. A lower FCR means fewer raw materials are used to create biomass, another critical sustainability issue.

The table below compares FCRs across several species grown for industrial consumption:

 Salmon: 1.3:1	 Poultry: 1.9:1	 Swine: 3.9:1	 Cattle: 8.0:1
---	---	---	--

Source: Mowi 2022 Salmon Handbook

150x

minimum more protein per hectare, compared to soy, with significantly lower water consumption.



Picture Source: Beta Bugs Website

1.2:1

is the FCR of BSF larvae, among the best in the insect and traditional protein industry.

04

THE BSF PRODUCT

BSF has applications in aquaculture, terrestrial protein, pet food, human supplements, biopesticides, and pharmaceuticals.

These sectors, which need to reduce unsustainable inputs, have well-established, high-volume demand end markets with attractive margins for top-quality proteins. Currently, the industry is less prone to the scrutiny of farmed insect welfare, unlike other animal-derived protein categories that have taken a public shellacking in recent years for their industrial processes. However, it is worth noting that this is changing, with producers and industry bodies actively working on developing welfare frameworks.

Investors love BSF protein's diverse and growing applications as it creates more paths to stabilize future cash flow stability. Some novel protein companies, for example, focus on addressing a specific niche, such as aquaculture feed. They found that their time to market was significantly stretched by aquafeed's oligopoly and unrealistic price expectations compared to fish meal.

Meanwhile, markets ranging from organic pet ingredients to fertilizer and terrestrial feeds have embraced novel proteins in their formulas. And emerging uses for pharma and biopesticides are estimated to have high prices for consistent and quality products. In addition, there is scope for BSF products to be used directly in human food, also a high-margin product. However, this will vary from region to region due to legislative frameworks and overcoming a "yuck" factor ascribed to Western consumers.

Insect Industry Pricing

Product	Current Price
Dried Insects	\$1750-2000/ton
Insect Protein	\$2500-3500/ton
Insect Oil	\$2000-3000/ton
Insect Frass	\$30-50/ton

Source: Beta Bugs

The Circular Economy in Action

In a world where 40% of the food, on average, goes to landfills or into other waste streams, BSF provides an attractive solution to the problem. BSF can be fed onsite waste from other food processes, recycling organic waste into high-value end-products used by the same industries to produce other products, minimizing the use of new raw materials. It's the circular economy in action!

Occasionally, BSF companies could even be paid for taking away waste, further driving potential investor interest. However, these "tipping" arrangements might not last when the companies creating the waste realize the value they are losing; in some instances, BSF producers already have to purchase their substrates, adding to the cost of production.

05

INDUSTRY BARRIERS

Scaling | CAPEX | Financing



Like all new protein production processes, there are inherent challenges regarding scaling and CAPEX in BSF. Equity, as opposed to debt/asset finance, is largely fueling BSF industry growth, but this should align with legacy protein producers as the sector is de-risked and production standardized.

OPEX Costs



OPEX costs remain elevated from labor at these facilities as the BSF industry continues to industrialize and manufacture automation tools to streamline production. It's an evolution that needs to occur as companies scale and seek to maximize their margins.

Energy Demand



And while BSF addresses food and waste sustainability, there is a tradeoff in its energy demand. A warm environment is required for BSF breeding and its use in biodegradation, which can be difficult and/or expensive to maintain in temperate climates.

Commercialization



Lastly, commercialization for BSF is in its early stages. There are feed diets that have started to integrate it. Pet food and organic or small-scale chicken producers also use it, but how will the price be impacted as volumes scale?



Commodity products have a way of declining as consistent supply becomes available, but will operating costs tighten enough below this equilibrium price?

06

THE FUTURE OF BSF

It's no secret the world needs more sustainable protein, and food waste must be addressed. Investors vote with their dollars, believing insects will be part of the solution.

BSF stands out among end markets, with its biological performance and economics scaling in the right direction. Its positive environmental impacts and livestock welfare benefits also provide a significant bonus, enabling insect farmers and agri-food supply chain partners to develop sustainable brands and initiatives such as Morrison's Zero-Carbon Eggs and Protix's Friendly Fish™, with other players such as Skretting also joining in.

These first initiatives enable insect protein to enter the market. Still, growing pains are likely to occur going forward: OPEX costs have a way to go, dependent on innovation and automation coming into the field to improve labor and energy costs.

And prices, while attractive, have yet to see what a competitive market may do as supply in earnest comes online.

Yet, growing pains pass: as a result of the industry's efforts to date, insect farming has become increasingly accessible, with multiple turnkey solutions now available, removing the need for spending time in extensive R&D and planning phases. As a result, a new generation of operators and insect farmers will enter the market to compete in supplying current and future demand for insect protein.

Overall, we remain very bullish on the future of BSF and feel that in due course, it will become a recognized player in the global agribusiness market.

WANT MORE?

For more on this topic visit our website.



Peritus Capital LLC is a minority-owned and operated boutique investment firm that invests in, supports, and finances the global development of early-stage and established companies that integrate Environmental, Social, and Governance (ESG) principles into their business models. We are a global team with an extensive network of international investors able to invest across multiple geographies.

