BLACK SOLDIER FLY BASED FISH MEAL
MVP 1
Living Lab KU

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1. Overview

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1.1. Abstract

Fish production faces challenges due to high cost of manufactured feeds. Therefore, alternative feed ingredients that are cheap and sustainable need to be put in place. An insect such as BSF serve as alternative solution due to its high protein and fat content, ability to consume a wide variety of organic wastes and requires low installation costs.

1.2. Photos



Figure 1: Steps of BSF pellet production



Figure 2: BSF based fish pellets

1.3. Motivation and challenges tackled

Aquaculture production in Kenya and across the world faces a major constraint: the high cost of conventional fish feeds, which account for more than 60% of total production expenses. Dependence on traditional protein sources such as fish meal and soybean meal not only reduces profitability but also impacts the long-term sustainability of smallholder fish farming. These feeds are expensive, environmentally taxing, and often competitively sourced between human food needs and livestock industries. This creates an urgent need for affordable, sustainable, and locally available alternatives that can support optimal fish growth and survival.

This study responds to these challenges by examining Black Soldier Fly (BSF)–based fish meal as a practical and scalable substitute for conventional protein ingredients. BSF meal is highly nutritious, rich in essential amino acids, environmentally friendly, and inexpensive to produce. It can be generated from organic waste streams, contributing significantly to waste recycling and circular economy initiatives.

By comparing BSF-based fish meal diets with traditional fish meal diets in Nile tilapia (Oreochromis niloticus), the study aims to provide robust evidence on growth performance, feed conversion ratios, nutrient utilization, and survival rates. Ultimately, the findings will inform cost-effective feed formulations, reduce dependence on costly imported protein sources, and promote sustainable aquaculture practices that enhance the resilience and profitability of smallholder fish farmers.

1.4. Feedback process

A key component of this collaboration involves direct engagement with KM farmers, who are actively participating in the innovation process. Through training sessions, on-farm demonstrations, and feedback meetings, farmers have been introduced to BSF rearing techniques and the practical use of BSF-based feed. As a result, several farmers in the region have already adopted the innovation and are successfully using BSF larvae to feed their chickens. Their hands-on experiences provide valuable insights into feed performance, cost savings, and management practices.

2.1. MVP Design

a) BSF Rearing Unit

A small-scale modular rearing system built using locally available materials, designed to:

- Efficiently convert household, market, and agricultural organic waste into BSF biomass
- Operate at low cost, requiring minimal energy and labor
- Produce consistent quantities of larvae suitable for meal production



Figure 3: Reproduction cage



Figure 3: Feeding trays

b) BSF Processing Module

A simple processing setup that includes:

- Harvesting trays
- Solar or mechanical drying equipment
- A grinding unit for processing dried larvae into BSF meal
  This ensures a clean, safe, and standardized fish meal product that meets basic feed quality guidelines.



Figure 4: Extruder machine

2.2. Operations

Step 1: Organic Waste Collection and Sorting

- Users collect biodegradable waste from households, markets, farms, or food processing units.
- Waste is sorted to remove plastics, metals, or non-biodegradable materials.
- High-moisture waste is pre-dried if necessary to improve the substrate quality.

Step 2: Waste Preparation

- Waste is chopped or shredded to increase surface area for larvae feeding.
- Mixed to achieve a uniform substrate suitable for BSF digestion.

Step 3: BSF Egg/Neonate Introduction

- BSF eggs or newly hatched larvae are introduced into prepared waste trays.
- Rearing units are placed in shaded, well-ventilated areas to maintain optimal conditions (25–30°C and adequate humidity).

Step 4: Larval Growth and Biomass Conversion

- Larvae feed on organic waste for 10–14 days, rapidly converting it into biomass.
- Farmers monitor moisture, temperature, and larval density to ensure maximum growth efficiency.

Step 5: Larvae Harvesting

- Mature larvae (approximately 14–18 days old) are separated from residual waste using simple sieves or harvesting trays.
- Part of the larvae may be left to pupate and sustain the colony for continuous production.

Step 6: Processing Into Fish Meal

- Harvested larvae are washed (optional), then dried using solar dryers or mechanical dryers.
- Dried larvae are ground into a fine BSF fish meal powder.
- The final product is packaged in airtight bags for feed formulation or direct use.

- BSF fish meal is mixed with other feed ingredients for aquaculture diets.
- farmers may also feed whole larvae or meal directly to chickens.
- Users observe growth performance, feed intake, and animal health.

3. Economics

3.1. Business model

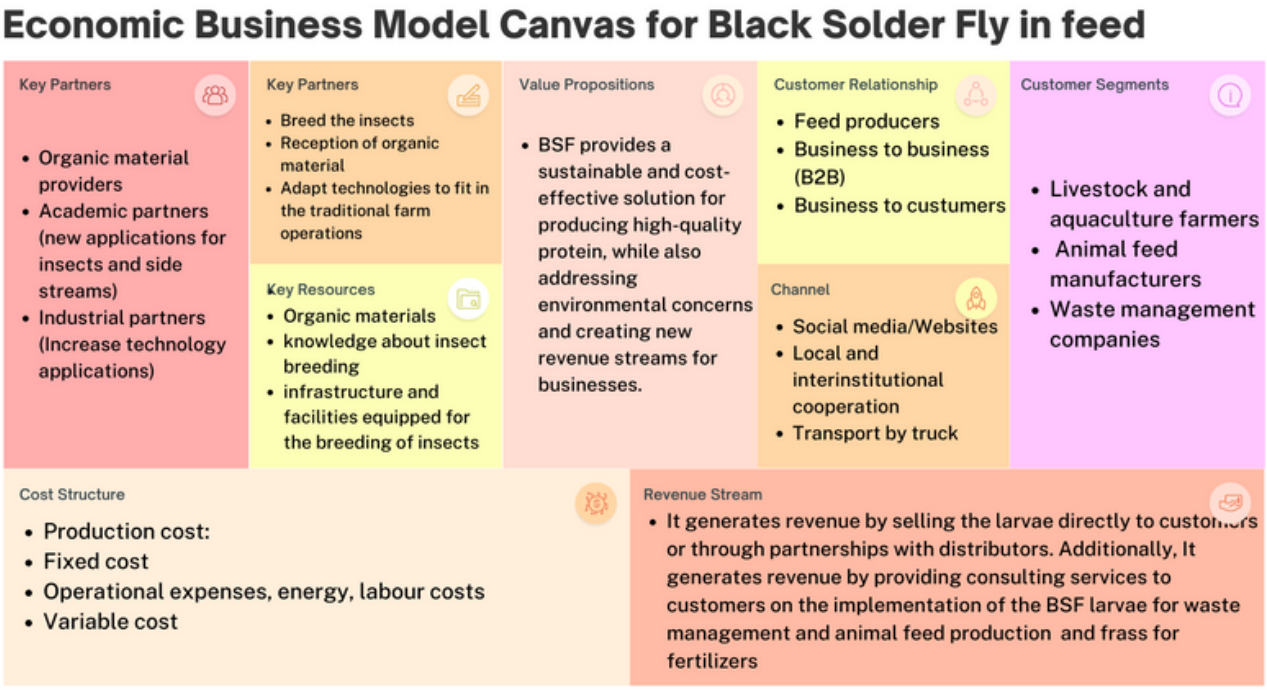


Figure 6: BMC for BSF in feed

4. Future improvements

4.1. SWOT analysis

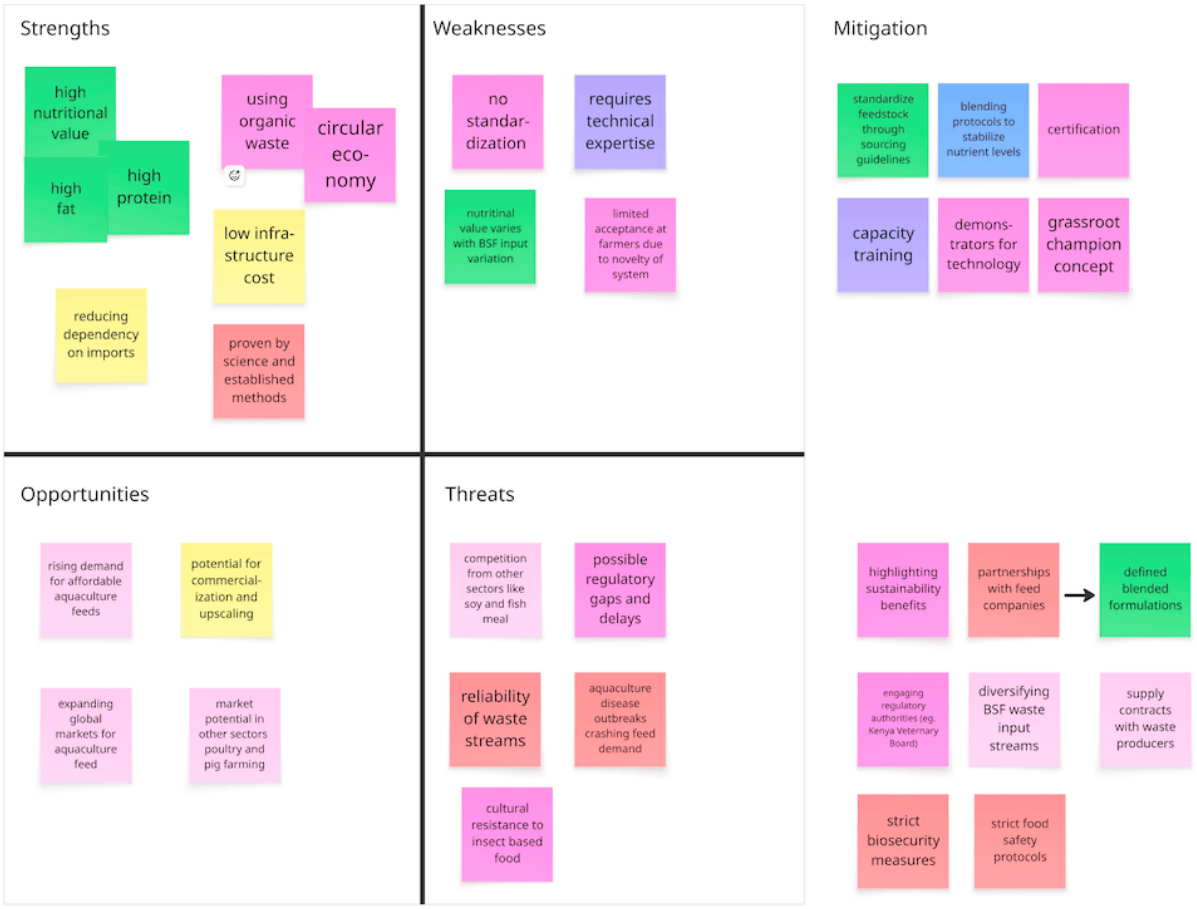


Figure 7: SWOT – KU LL – BSF based fish meal

Strengths (Internal)

- High nutritional value: rich in protein and fat suitable for fish growth.
- Cost-effective production using organic waste substrates.
- Low infrastructure and installation costs compared to conventional feed sources.
- Enhances circular economy through organic waste recycling.
- Reduces dependence on expensive fish meal and soybean imports.
- Supported by established analytical methods (AOAC, 2005) and university laboratory facilities.

Weaknesses (Internal)

- Limited large-scale production and standardization in Kenya.
- Requires technical expertise in rearing and feed formulation.
- Nutritional composition may vary depending on waste substrate quality.
- Short project timeframe may limit long-term impact evaluation.
- Initial acceptance challenges from farmers due to novelty of insect-based feeds.

Opportunities (External)

- Rising demand for affordable aquaculture feeds due to growth in fish farming.
- Potential for commercialization and local feed industry uptake.
- Strong alignment with government and donor interests in sustainable agriculture and waste management.
- Expanding global market for insect-based protein feeds.
- Potential to scale findings to other livestock sectors (poultry, pigs).

Threats (External)

- Competition from conventional feed producers (fish meal, soybean industry).
- Possible regulatory gaps or delays in approval of insect-based feeds.
- Fluctuations in availability/quality of organic waste streams.
- Risk of disease outbreaks in aquaculture affecting demand for feeds.
- Farmer skepticism or cultural resistance to insect-based feeds.

4.2. Optimization

Quality and consistency

1. Standardize feedstock through common sourcing guidelines.
2. Blending protocols to stabilize nutrient levels.
3. Certification.

Poor farmers' awareness

1. Capacity building and training
2. Demonstrations
3. Having grassroots champions - KU LL is in close contact with one farmer who already have a face book and she is advertising the use of black soldier fly as chicken feeds. She is providing the starter kit for farmers.

Data-based evidence

1. Collaborative research
2. Findings dissemination workshops

4.3. Threat mitigation

Competition from conventional feed producers

- Highlight cost savings and sustainability benefits in dissemination. Build partnerships with feed companies for blended formulations instead of direct competition.

Regulatory gaps or delays in approval of insect-based feeds

- Engage early with regulatory authorities (e.g., KEBS, Kenya Veterinary Board) to align with existing feed standards. Share safety and nutritional data from the trials to support policy uptake

Fluctuations in availability/quality of organic waste streams

- Diversify waste sources (vegetable markets, food processors, farms) and develop standardized substrate formulations (vegetable waste + wheat bran). Establish supply agreements with waste producers.

Risk of aquaculture disease outbreaks reducing demand for feeds

- Maintain strict biosecurity measures in fish trials. Highlight the resilience of BSFL feeds as cost-saving even under fluctuating production. Explore other livestock feed markets as backup.

Farmer skepticism or cultural resistance to insect-based feeds

- Use demonstration trials and farmer field days to showcase performance results. Package findings into farmer-friendly extension materials. Leverage testimonies from early adopters to build trust.

5. Appendices

5.2. Additional Photographs/Documentation



Figure 8: Monitoring of BSF larvae health and fattening success



Figure 9: Eggs counting



Figure 10: Weighing of fish harvest to assess fattening success



Figure 11: BSF Production system



Figure 12: KM Extension: BSF Production Unit opening -Located in an informal settlement north of KU



Figure 53: KM champion farmer with harvested and sun dried BSF larvae destined to be chicken feed



Figure 14: BSF based product exhibited at the Nairobi International Trade Fair in 2025



Figure 15: Black Soldier Fly based aquaculture pellets