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BioProtein Hub: Sustainable Insect Protein Production and Animal Feed Cost Optimisation

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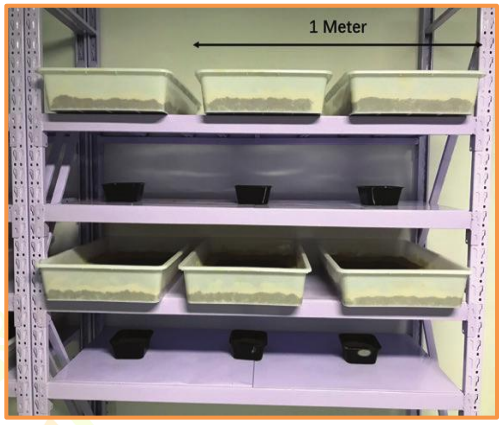
The IGO BioProtein Hub is a proposed Black Soldier Fly (BSF) larvae production project designed to support sustainable and cost-effective animal feed production. The project will use a 1,000 sq.ft. facility with a four-tier vertical rack system, comprising a proposed 60 racks and 240 trays. Suitable organic by-products will be used as rearing substrates to produce larvae for processing into a protein ingredient for poultry, duck and fish feed. The project will focus on efficient space utilisation, larval growth, harvesting, processing and product quality. Production yield and operating costs will be monitored through pilot trials to evaluate the feasibility of the proposed system. The long-term objective is to develop a practical insect-based protein production model that may reduce dependence on conventional feed ingredients and improve resource efficiency in agriculture.



Introduction

Animal feed costs are increasing, so farmers need affordable and sustainable feed options. Black Soldier Fly (BSF) larvae (Hermetia illucens) contain protein, fat and can grow on suitable organic waste. Through the IGO BioProtein Hub, IGO Agritech Farms plans to produce BSF larvae using a four-tier vertical rack system. The project will use suitable organic waste to grow larvae, make better use of available resources, and produce protein ingredients for poultry, duck and fish feed. It will also study larval production, feed quality and the potential to reduce feed costs.

Objectives of the Study

The main objectives of the IGO BioProtein Hub are:

- To establish a 1,000 sq.ft. BSF production unit.
- To use a four-tier vertical rack system with a proposed 60 racks and 240 trays.
- To use suitable organic and agricultural by-products as larval feed.
- To produce BSF larvae for poultry, duck and fish feed.
- To develop proper breeding, harvesting and processing methods.
- To study production yield, feed quality and operating costs.
- To assess the project's commercial potential.

BSF Production Unit Design and Layout

IGO Agritech Farms proposes a 1,000 sq.ft. BSF production unit using a vertical rack system. The plan allocates 600 sq.ft. for rack footprints and the remaining 400 sq.ft. for gaps, walking aisles and access space.

The unit is planned to have 60 racks, with four tiers and four trays per rack, giving a total of 240 trays. The final rack arrangement will be checked to ensure enough space for movement, ventilation and cleaning.

BSF Production Technology and Breeding Process

The process will begin by purchasing live BSF larvae from a reliable supplier. The larvae will be fed suitable prepared organic materials and monitored during their growth. Some mature larvae will be kept for breeding to produce future generations. The remaining larvae will be harvested and processed for use as animal-feed ingredients. The main steps include preparing the feed material, rearing the larvae, monitoring growth, harvesting, heat treatment, drying and safe storage. Production and cost records will help evaluate the system's performance and commercial potential. Breeding and feed production will be managed separately to maintain a regular supply of larvae. Pilot production will help identify the most suitable methods and operating conditions

Substrate Selection and Preparation

At IGO Agritech Farms, suitable organic by-products and agricultural residues will be evaluated as substrates for BSF larval growth. Selecting the right substrate is essential for healthy larval development, consistent production and economical operation.

Suitable Substrate Materials

Substrate	Purpose
Vegetable and fruit processing residues	Provide organic nutrients for larval growth
Selected agricultural by-products	Support biomass production
Suitable food-processing residues	Offer an alternative substrate, subject to safety requirements
Approved plant-based organic residues	Improve resource utilisation

Substrate Preparation Process

1. Collection
2. Sorting
3. Size reduction
4. Moisture adjustment
5. Quality inspection
6. Controlled feeding

Vertical Rearing System and Space Utilisation

IGO Agritech Farms proposes a vertical rearing system to produce BSF larvae efficiently within the planned 1,000 sq.ft. facility. By arranging rearing trays on multi-tier racks, the unit can utilise vertical space and organise larval production in manageable batches.

Advantages of Vertical Rearing

- Makes better use of the available floor area.
- Allows multiple production batches to be managed systematically.
- Supports organised feeding, harvesting and cleaning.
- Creates opportunities for monitoring production and labour requirements.
- Can support expansion by adding suitable rack capacity.

Yield Estimation and Rack Calculation

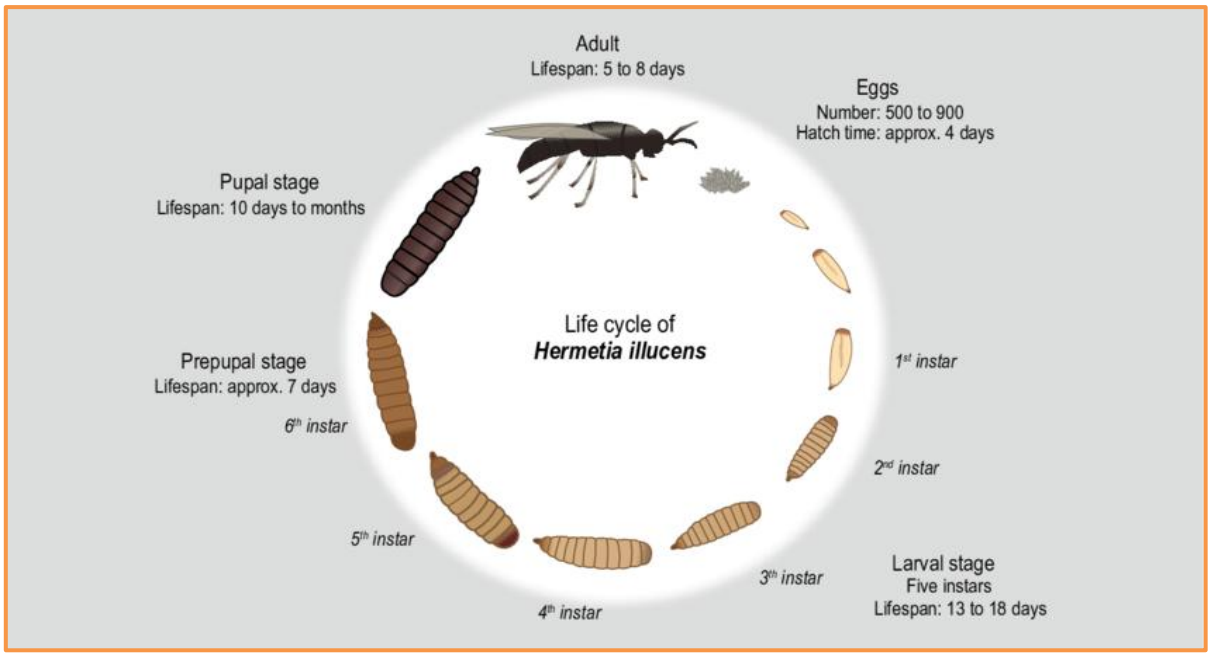
The proposed IGO BioProtein Hub will use a four-tier vertical rack system to increase production capacity within the available space. The unit is planned with 60 racks and 240 trays, subject to final layout verification. Each rack will have four tiers, with one tray per tier.

Each tray will measure 2 × 4 ft, providing a surface area of 8 sq.ft. Each rack will measure 4 × 2.5 ft and occupy 10 sq.ft. of floor space. The total rack footprint will be 600 sq.ft, while the remaining 400 sq.ft. will be used for gaps, walking aisles and access space. The final arrangement must provide sufficient space for ventilation, cleaning and safe movement.

Temperature and moisture play an important role in BSF larval growth. A starting temperature range of approximately 27–32°C may be considered, with substrate moisture around 60–70%, depending on the material used. Good ventilation and daily monitoring are necessary to maintain suitable growing conditions. These values should be adjusted based on pilot-trial results.

For initial planning, each tray is assumed to receive 1 kg of live larvae and 5 kg of wet substrate. For 240 trays, this equals 240 kg of live larvae and 1,200 kg of initial wet substrate. Based on an earlier illustrative estimate for 80 trays, scaling to 240 trays gives a possible planning range of 180–300 kg of fresh larvae and 48–84 kg of dried larvae per batch. These are estimates, not guaranteed yields. Actual output will depend on larval survival, substrate quality, feeding rate, environmental conditions and processing methods.

The project may initially plan for one or two batches per month, subject to the actual growth cycle, cleaning time, breeding requirements and processing capacity. Pilot trials are necessary to establish reliable production figures. Harvested larvae intended for feed processing should be separated from the substrate, inspected, heat-treated using a validated process and dried to a suitable moisture level. The dried material may then be milled if required, tested for quality and safety, and stored hygienically. Larvae reserved for breeding must remain alive.



Feed Cost Comparison: Normal Feed vs. BSF-Enriched Feed

BSF larvae can be processed into a protein-rich ingredient for poultry, duck and fish feed. Their use may reduce dependence on conventional protein ingredients when the meal is nutritionally suitable and economically competitive. For illustration, a hen consuming 110 g of feed per day would receive 5.5 g of BSF meal at a 5% inclusion level. A duck consuming 150 g per day would receive 7.5 g. For a fish weighing 100 g, an illustrative daily feed allowance of 2 g would correspond to 0.1 g of BSF meal at the same inclusion level. These values are examples, not final feeding recommendations. Actual inclusion rates depend on the animal species, age, nutritional needs and composition of the BSF meal. BSF meal should be part of a balanced diet, not the only feed source. Potential savings will depend on the cost of producing BSF meal compared with the conventional ingredient it replaces. Substrate handling, labour, electricity, heat treatment, drying, testing, equipment and storage must all be included when calculating the actual cost per kilogram.

Production Monitoring and Quality Control

Regular monitoring is essential for consistent production and safe feed ingredients. Each batch should be recorded separately, including live larvae input, substrate quantity, temperature, moisture, larval survival, fresh harvest and dried output. Processing expenses and batch duration should also be recorded. These records will help improve production efficiency and estimate the cost of producing each kilogram of fresh larvae or dried meal. The final product should be tested for nutritional composition and relevant microbiological and chemical contaminants. Suitable substrates, hygienic handling, validated processing and proper storage are important for maintaining product quality and safety.

Resource Utilisation and Sustainability

The IGO BioProtein Hub aims to convert suitable organic by-products into useful insect biomass. This may improve resource utilisation and reduce the amount of suitable organic material sent for disposal. The vertical rack system is designed to make efficient use of floor space. Careful substrate selection, controlled feeding, proper waste management and hygienic processing will support sustainable operation. The material remaining after larval rearing may have potential for use as a soil amendment or compost. Its suitability must be assessed according to the substrate used, material quality and applicable requirements before agricultural use.

Commercial Feasibility

The commercial success of the IGO BioProtein Hub will depend on consistent larval production, product quality, processing efficiency and market demand. Pilot trials should measure actual fresh and dried output under the proposed operating conditions. The cost of producing one kilogram of dried BSF meal should include substrate, labour, electricity, processing, equipment, testing, packaging and storage. This cost can then be compared with conventional feed ingredients while considering nutritional value and feed formulation requirements. Expansion should be considered only after the project demonstrates reliable production, acceptable product safety and practical operating costs. The results will help IGO Agritech Farms decide whether the system is suitable for larger-scale operation.

Conclusion

The proposed IGO BioProtein Hub aims to produce BSF larvae through a four-tier vertical rack system in a 1,000 sq.ft. facility. The project will focus on larval rearing, breeding, harvesting and processing. The harvested larvae may be processed into protein ingredients for poultry, duck and fish feed. Pilot trials will help establish actual production yield, product quality, operating costs and the potential to reduce feed expenses. Final production capacity will be confirmed through layout verification and practical testing.