



Food and Agriculture
Organization of the
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IS THE TIME RIPE FOR USING INSECT MEAL IN AQUAFEEDS?

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More and more companies are producing the larvae of insects such as mealworms and black soldier fly for use in aquafeeds, but the sector has a long way to go before it can match either the volume or price of fish meal.

A key pillar of blue transformation is reducing the amount of fish meal included in aquatic animal feeds by replacing it with other protein sources, including plant and algal material, as well as insect meal.

It has been known for a long time that insects can convert agricultural food wastes into larvae and that these larvae can be fed to aquatic animals, potentially reducing feed costs. In 1982, a Voluntary Service Overseas worker encouraged the Isaan Development Foundation in Udon Thani, Northeast Thailand, to integrate pig and fish farming and also to process maggots from pig manure. Ten kilograms of wet pig manure produced approximately 1 kg of maggots, which were collected using a wire mesh screen and fed to catfish grown in cages.

Applied research and trials on the production of insect meal and its inclusion as a protein source in terrestrial and aquatic animal feeds has been ongoing for over a decade. Trials conducted in Thailand in 2016 showed that larval whiteleg shrimp (*Penaeus vannamei*) fed with insect meal performed at least as well in terms of survival and growth as larval whiteleg shrimp fed with a market-leading shrimp diet which contained fish meal.

Despite the promise of using insect meal to replace fish meal, bringing this to commercial fruition is taking longer than developers and investors want and, despite over USD 1 billion being invested in the sector to date, only 10 000 tonnes of insect meal were produced in 2020 (Fletcher, 2021).



However, the recent establishment of several partnerships between insect producers and multinational aquafeed companies, suggests that insect production for aquafeeds is only likely to increase. Although the current price of insect protein ranges between EUR 3 500/tonne to EUR 5 500/tonne, compared to fish meal which ranges from EUR 1 000/tonne to EUR 1 700/tonne, the price of insect meal has been forecast by a leading seafood analyst to fall by EUR 2 000 when the sector has matured (Fletcher, 2021). Moreover, the sustainability benefits that insect protein can offer animal feed manufacturers – such as decreasing their dependency on marine ingredients – combined with the marketing advantages of insect-fed fish and shrimp, might be able to justify a slightly higher insect meal price.

According to a recent report, 500 000 tonnes of insect protein will be produced by 2030, of which aquafeed will utilise 200 000 tonnes, petfood 150 000 tonnes, poultry 120 000 tonnes and piglets 30 000 tonnes (Rabobank, 2021). While this figure is not insignificant, it is still less than 1 percent of the volume of fish meal used in the global aquafeed market currently, suggesting that insect meal will remain a relatively niche ingredient for the foreseeable future.

SCOPE AND SCALE OF APPLICATION



Insect farming can be done on a variety of scales and at different levels of technological complexity – from backyard production to large-scale systems that are highly automated and closed. Farming of black soldier fly (*Hermetia illucens*) is currently the most widespread form of global insect farming. In 7 to 10 days, depending on temperature, the species can convert organic wastes into larvae, with a feed conversion ratio of 1.5. The larvae have a protein content of 40 percent to 65 percent (live weight) and contain essential amino acids, beneficial lipids and other nutrients, depending on their feed (Gligorescu *et al.*, 2021).

Black soldier fly larvae can be grown to a specific size, making them suitable as feed for different life cycle stages of aquatic animals. They can also be dried and sold as a protein-rich insect meal, after being pasteurized, defatted, dried and ground up for inclusion in animal feed for poultry, pigs, shrimp, fish and pets.



Black soldier fly production

ACCESSIBILITY

Insect farming is currently being conducted in both developing and developed countries. The Sanergy organic waste plant in Kenya processes 72 000 tonnes of organic waste a year (Sanergy, 2021) and is an example of a centralized black soldier fly production unit that treats organic waste from cities. Several companies and startups have emerged in the insect-farming sector in recent years – two of the largest are based in France.

In Asia, several insect-farming companies and research projects secured funding from agricultural food companies during 2021. The Bangkok-based Asian Food and Feed Insect Association (AFFIA) is trying to promote insect meal production in Asia and currently has 12 members producing insects for animal feed (AFFIA, 2021).

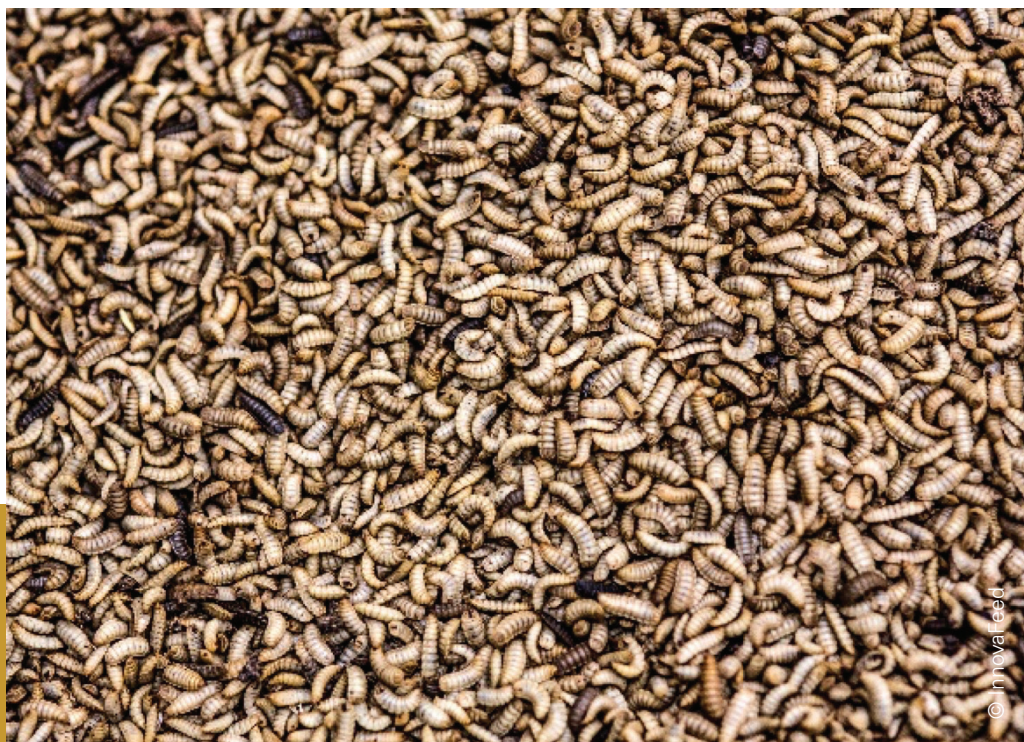
There are planning and logistical challenges to scaling up insect meal production facilities and they need to be located close to a reliable source of agricultural by-products or other organic wastes. However, these wastes, particularly in Asia, have multiple-use options – including pig, chicken and fish feeds as well as for composting and as a soil fertilizer – so black soldier fly production facilities have to compete price-wise for a regular organic waste supply. Transporting organic wastes over long distances, particularly in warm and tropical climates, also results in odour and the risk of contamination, which can become a food safety issue that has to be mitigated.

TECHNIQUE AND APPROACH USED

A Dutch company offers black soldier fly production systems, ranging from those capable of processing 1 tonne to 2 tonnes of organic waste per day for EUR 375 000, up to those processing 80 tonnes of organic waste daily for EUR 2.5 million. The systems are closed and use high technology and a modular production method to ensure food-safe production conditions.

Feedback from insect meal producers suggests that Malaysia and Viet Nam have very different requirements for the establishment of insect meal production facilities and, as a result, Malaysia has three insect meal production companies, while Viet Nam has only one.

Current European Union legislation permits insects as feed for chickens, pigs and aquaculture but European Union regulations still prevent insects from being fed on organic animal wastes, including litter. This has significantly increased the costs of insect meal produced within the European Union. Despite this, several of the world's largest insect producers are based in Europe.



Black soldier fly larvae

WHAT MAKES IT AN IMPROVEMENT?

The commercial production of black soldier fly larvae and mealworms are examples of both nature-based solutions and the circular economy, as insects are used to treat organic wastes and then produce larvae that can be fed directly to terrestrial or aquatic animals or otherwise processed into high-quality insect meal.

One particularly interesting example involves researchers in Norway, who are currently conducting trials to collect and dry sludge from land-based smolt farms. The dried sludge can then be fed to black soldier flies, whose larvae are processed into insect meal.

Farming of insects requires minimal land area, limited water use and its greenhouse gas emissions are reported to be relatively low. It is also a valuable alternative to the use of fish meal. Trials also suggest that the inclusion of a proportion of insect meal in aquafeeds could have health benefits for a variety of farmed fish and shrimp species. In addition, the nutrient-rich waste produced by insect larvae, known as frass, can also be sold as a natural fertilizer.





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FAO Regional Office for Asia and the Pacific
FAO-RAP@fao.org
www.fao.org/asiapacific/en/

Food and Agriculture Organization of the United Nations
Bangkok, Thailand



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