

Insects turn waste into stockfeed and fertiliser

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Organic waste generated on farms and in food gardens is a problem. Some waste can become an environmental hazard if not disposed of properly. Composting or incineration of waste are not always economical solutions. Organic waste holds nutrients we don't want to lose from our farms. Black Soldier Fly larvae (BSFL) production systems could be the solution.

Work is continuing at NARI's Momase Regional Centre (MRC) to use BSF larvae to deal with the kinds of organic waste generated in PNG's mixed livestock-crop farming systems.

In PNG an estimated six hundred thousand tons of organic waste is produced annually. Farmers need to dispose of plant materials like weeds and prunings, crop residues like coffee pulp and coconut husks, animal manures and domestic food waste.

We need this organic waste to be dealt with in ways which are environmentally sustainable, economically viable and fair to all.



"Eggies" on very smelly waste in the "Love Cage".

Insects are responsible for much of the natural decomposition of organic waste. We all know the problem of flies around anything rotten! What if these flies can be harnessed to produce materials we want from the waste that we need to get rid of?



Larvae ready for harvest.

Black soldier flies usually lay their eggs in organic materials that will be food for their larvae. In the BSF production system at NARI pupae are placed in a netted cage where they emerge as adults and mate. The females lay their eggs in the spaces between stacked pieces of wood that have been placed over smelly waste like fish intestines and pig manure. The smelly waste is attractive to the flies as it signals available feed for their offspring. This waste is referred to as the seed substrate. Every two days the egg collecting structures called “eggies” are removed and placed in a tray over a starter feed substrate made with mill run and water. The eggs hatch and drop on to the starter feed where they burrow under and start eating. After 8 – 10 days the larvae are moved on to their main diet of chopped up kitchen waste. Another 10 – 14 days and they’re ready to harvest. They will eat and can cope with a wide variety of materials ranging from fibrous crop residues to high nutrient manures. They can cope with a wide pH range. Climatic conditions of warm temperatures and high humidity found here in Lae are ideal for the BSF.

Martin Raurela, who manages the BSFL facility for larvae production at NARI's MRC, says "BSFL is an exciting innovation in organic waste management. It is a potential source of protein feed for livestock. Frass, the residue from decomposition of the organic waste, can be used as fertiliser and soil amendment for crops. There has been an increase in animal feed and fertiliser costs. BSFL could be a solution, especially for our small holders, since it is free and available. Here in MRC LABU, we are currently focusing on farming the insect to produce larvae for animal feed and the frass for fertiliser to be used by our crops team. The BSF Larvae are found on the station in kitchen waste from the NARI Guest House and Coffee Shop. The larvae are collected and fed kitchen waste until they pupate into adult flies. The farming method is similar to the fly's environment, but they complete their full life cycle in captivity. We harvest the larvae and frass. The larvae have been tested as fish feed and we will soon move on to future trials with other livestock such as chickens. The BSFL facility here at Labu is in progress to reach full larval production capacity." At the current operating scale, the facility produces around 1,350-day-old larvae each day, which daily process around 1.7 kg of organic waste, yielding approximately 150 g of harvested larvae biomass and 300 g of raw frass.

The larvae grow rapidly, decomposing the waste as they feed, and become a rich source of nutrients, especially protein and fat. They are ready to be harvested when they reach the 5th [instar](#). are then around 20 mm long and 10 mm in circumference. Typically they will be 40% protein, 20% fat and have an ash (mineral) content around 20%, making them ideal food for monogastric animals like chickens, pigs and fish. At this stage they can be fed fresh to livestock or oven dried and packaged for longer life storage. This bio-recycling of waste means nutrients are retained to be used on farm and costs for stockfeed are reduced. The waste from the larvae is called frass. Together with the remaining decomposed material it can be used as a fertiliser or as a conditioner to improve the soil. It is odourless and has a high mineral content. It could be particularly convenient to use in a plant nursery for raising seedlings or growing cuttings but is also useful out in the food garden.

These are economic, environmental and social wins – the farmer keeps nutrients and saves money and there is less contamination of the environment from waste.

An added benefit could be reduction in disease as waste containing Salmonella, E. coli and other disease-causing bacteria are rendered safe after bio-recycling. The

adult BSF do not transmit disease, unlike the common housefly. The larvae also biodegrade some pesticides and pharmaceuticals preventing them contaminating the environment.

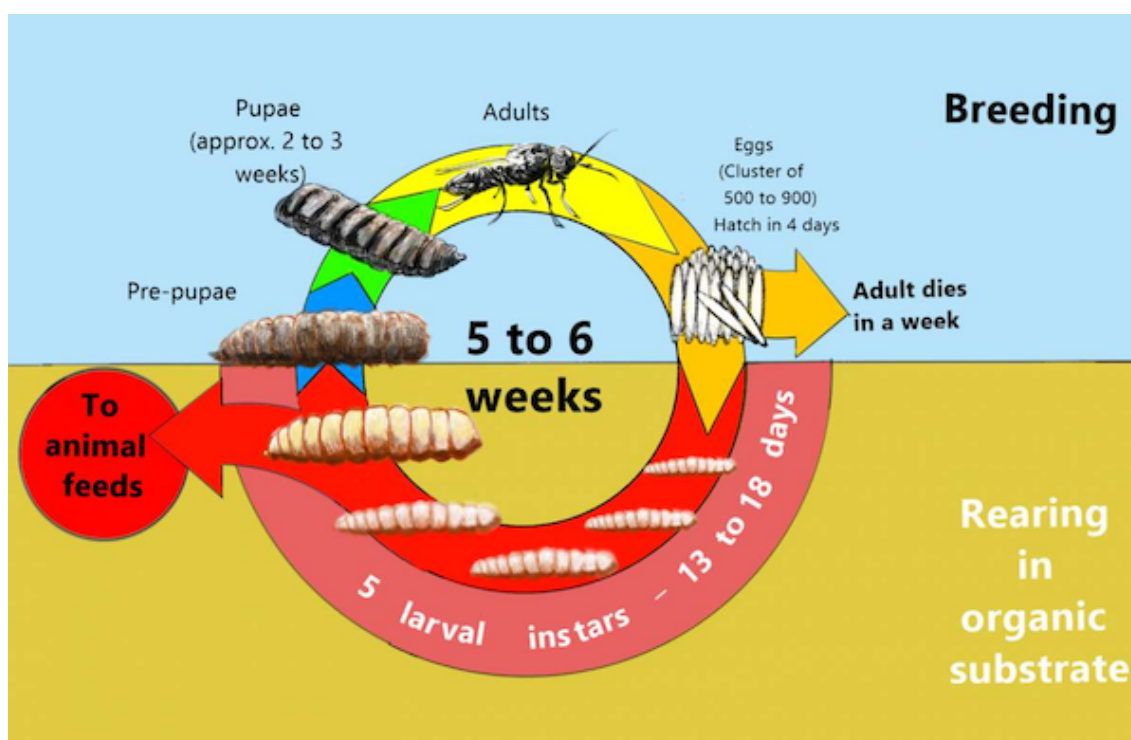
BSFL systems can be quite small scale so are suitable for smallholder farms. They work within the farming system already underway dealing with the waste that is the inevitable result of that farming system. The equipment needed is readily available and relatively cheap.



Martin and Silister at the NARI facility.

The simplest BSFL system uses a large (120L) bucket with a lid. The bucket is filled over the course of a week with garden and kitchen waste. As it ferments it becomes smelly and attracts soldier fly females who will lay their eggs in the waste.

The eggs hatch and the larvae begin to feed. They will grow rapidly, shedding their skins 5 times on their way to becoming suitable for livestock feed. This will take around 13 – 18 days. When the larvae are at this 5th 7 stage the bucket contents can be tipped on to 5 mm mesh that has a tray underneath. The larvae burrow down away from the light and fall through the mesh onto the tray underneath. They are ready now to be fed directly to livestock or can be oven or sun dried for use later. If you have 3 buckets you can have a continuous flow of organic waste to larvae.



The life cycle of the Black Soldier Fly (Hermetia illucens), lasting approximately 45 days in its entirety. Before reaching the pre-pupal stage, BSF larvae are at their maximum nutritional quality as a feed resource. Source: Nutrinfo 2020.

Black Soldier Fly farming can also work as a small business enterprise. The equipment needed is cheap and readily available. You will need to construct a “Love Cage” where adult flies emerge and mate and the females lay eggs. The “eggies” where the eggs are laid can be made from wood offcuts from a builder’s yard with pieces of palm frond used to make the gaps. Discarded plastic containers can be repurposed as trays to hold the organic waste the larvae grow in. You will need some smaller trays for the youngest larvae and a darkened space for pupae to mature. Staff at NARI are working on a Standard Operational Procedure document

that should be available soon. It will give all the details on setting up your own system.



Old plastic containers can be repurposed.

BSFL can also be grown in a large scale system suited to municipal waste processing. In this case more sophisticated equipment is needed.

NARI encourages farmers to look into how BSFL production could work on their farms. Growing Black Soldier Fly Larvae on unwanted organic waste could be win-win!

References

Roberts, A. and Dom, M. (2024) Potential Application of Black Soldier Fly Larvae (BSFL; *Hermetia illucens*) as Efficient Converters of Under-utilized Organic Farm Wastes in Papua New Guinea. Interdisciplinary Journal of Papua New Guinea University of Technology, Vol. 1 No.1, 2024.

Nutrinfo. 2020. Using black soldier fly larvae as a source of protein. The Animal Nutrition. Available: <https://theanimalnutrition.com/en/using-black-soldier-fly-larvae-as-a-source-of-protein/>

Glossary

Instar: Insect larvae (such as maggots, caterpillars etc.) go through several growth stages with a skin moult at the end of each, before they become adults. These stages are called instars. Black Soldier Fly larvae go through 5 instars before becoming adults.

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<https://info.pngagriculture.net/biblioviewlist?cmd=search&search=black+soldier+fly&searchtype>

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