

Policy Briefing

Upscaling beneficial insect production in Ghana



Photos: ENTO-PRISE



The AgriTT programme is an innovative trilateral initiative between the UK Department for International Development (DFID), the Chinese Government, the Governments of Malawi and Uganda and the Forum for Agricultural Research in Africa (FARA). The programme facilitates the sharing of successful experiences in agricultural development with developing countries to improve agricultural productivity and food security.

The AgriTT Research Challenge Fund supported two year research projects to generate new thinking and practice on technology transfer and value chain development. Each project had a Chinese, UK, and African or South-East Asian research partner.

Using insects to process agricultural waste has two useful by-products – livestock feed and soil amendments

Rapidly urbanising Ghana faces multiple challenges: meeting the growing demand for animal-sourced foods; creating livelihood opportunities for the poor; and ensuring hygienic waste disposal. Local industry is threatened by low-cost imports of both agricultural inputs and products, while disposing of wastes from food chains has financial and environmental costs. Re-using organic waste to produce agricultural inputs could go some way to mitigating those costs.

Ghana's metropolitan areas, including Accra, Kumasi and Tamale, are experiencing growth of the intensive feedlot livestock sectors in their less densely populated peripheries to meet demand for animal protein from a growing middle class. The future sustainability of this sector (which includes poultry and tilapia) will require a reliable, cost-effective source of high-quality ingredients for nutritionally complete diets. And peri-urban smallholder fruit and vegetable farmers supplying these same urban markets need organic fertilisers to maintain the fertility of their soils.

Transforming waste using black soldier flies (BSF) can produce local inputs valuable for fish, poultry and crop production (see Box). The project assessed the potential of a diverse range of locally available organic wastes for BSF production, including livestock manure; fruit and vegetable wastes from open-air markets and supermarkets; fish and abattoir processing wastes; kitchen waste

from convenience food restaurants; and domestic waste collection.

This trilateral project – ENTO-PRISE – applied learning from emerging Chinese BSF value chains to pilot two insect-production systems in Ghana.

China has seen growing investment in production of insect larvae as a sustainable source of feed for rapidly expanding livestock and fish production sectors. Trials with Ghanaian partners built on Chinese experience in the production and use of larvae and their co-products. The project aimed to support an adaptive transition from traditional low-input/low-output insect-based waste processing at homestead level (using natural egg laying by mixed insect species for free-range poultry) to intensive peri-urban monoculture of high-yielding BSF that can feed on a diverse range of organic substrates.

Waste substrates and co-products were screened for potential contaminants and appropriate nutrient profiles. Green market wastes were identified as high-potential substrates for upscaling BSF production, based on low contamination risks, seasonal and spatial availability, life-cycle analyses, greenhouse gas emission profiles, and BSF yield assessments. In trials, both the co-products (BSF biofertiliser and maggot meal livestock feed) performed well, achieving up to 17% higher growth than controls. Guinea fowl trials showed great potential for simple dietary protein substitution with maggot meal (avoiding more costly dietary formulations), and application should also be assessed in the rapidly growing broiler poultry sector. Feeds for Guinea fowl were more successful than those tested for aquaculture in juvenile tilapia nutrition trials; BSF for

commercially viable aquaculture is likely to require additional processing.

Agronomy trials with locally important short-cycle cash crops (shallots and maize) showed BSF biofertiliser (10 t/ha) combined with inorganic fertiliser applications achieved up to 55% higher yield outcomes compared with the same inorganic fertiliser + poultry manure. Preliminary analyses also indicate improved soil moisture and nutrient retention.

Stakeholder analysis indicated good consumer acceptance of BSF co-products and a generally highly positive attitude to involvement in BSF production supply chains. However, cost-benefit analysis indicates a need

for further productivity gains to justify adoption by smallholders. These might be achieved through more efficient automated separation of white larvae, and the strategic use of heating to optimise growth during early larval developmental stages. Trials in controlled environment facilities point to potential upscaling using deep-bed systems with simple aeration and humidity management features.

Resources available on the ENTO-PRISE website (www.stir.ac.uk/ento-prise) include a guide to setting up new BSF facilities that includes demonstration videos; and a commercialisation section with links to companies that are currently generating and using the co-products of BSF.

Black soldier flies (*Hermetia illucens*) are widespread, harmless, beneficial insects. BSF do not bite or sting, and unlike pest flies they are not vectors of human diseases – the winged adults live only a few days so do not migrate between waste matter and humans for their food. But the larvae live for several weeks, consuming huge quantities of food waste or agricultural manure.



Photo: James Niland <https://www.flickr.com/photos/bareego/5542134996>

There are two useful co-products:

- the larvae are an excellent source of food for livestock
- the larval residue (castings) can be used as a soil amendment.

Policy recommendations

- **Further investment is needed in primary separation of inorganic components to reduce contamination risk.** This would mean the considerable investment that has already been made in municipal domestic waste collection in Accra (with Chinese bilateral support) could be used for value-added BSF production. For example, a waste-disposal and sanitation company in Ghana is actively engaged in trials to evaluate the performance of market waste-based composts with smallholder farmer collectives. However, currently the company can only attempt this with limited amounts of market wastes due to the lack of primary municipal waste separation.
- **A reliable substrate supply could be obtained through developing waste-gleaning networks like those found throughout much of Asia.** In China collectors of restaurant kitchen waste provide a major feed source for peri-urban smallholder livestock production. In southern China some of these gleaners have switched to BSF production following recent legislation banning urban livestock production (for public health reasons). In Ugandan fruit and vegetable markets, workers (mainly women) paid to collect wastes from stands could be supported to become the basis of a more commercial gleaning practice.
- **Commercial potential for BSF production is likely to be greatest in peri-urban areas of Ghana with co-located input-output supply and demand, and with associated sanitation benefits.** The project's production operation was modularised to facilitate controlled trials, and upscaled units would be necessary for cost-effective production. Small-scale, on-farm, co-located production has proved especially popular with smallholder poultry producers in China.

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With some additional investment in reducing contamination risk, the already considerable investment in municipal domestic waste collection in Accra could deliver significant economic benefits through value-added BSF production

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