

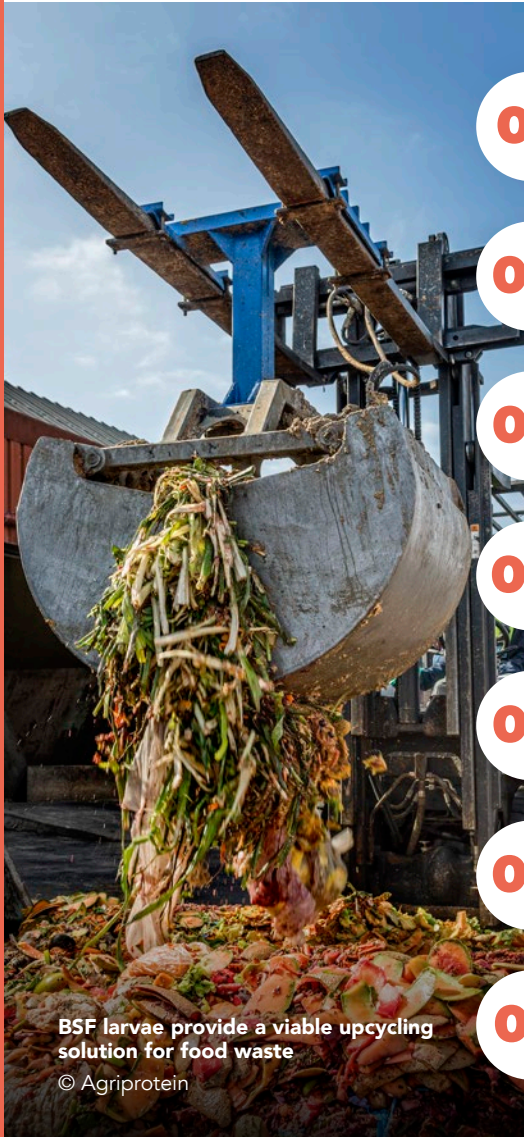


Food Waste Upcycling

Upgrading Food Waste to Insect Protein

1

Key points



BSF larvae provide a viable upcycling solution for food waste
© Agriprotein

01

South Africa's cities are running out of safe places to dispose of waste. Cape Town, for example, may run short of airspace as early as 2032.

02

In South Africa, food waste makes up a large proportion of landfilled waste. An estimated 14.5% of the City of Cape Town's landfilled waste consists of food waste, but this could be even closer to 20% based on other residual organics found at landfills.

03

When organic waste enters the anaerobic environment present in landfills, methane, a GHG, is produced and contributes to climate change.

04

Cape Town hosts a diverse number of cost effective food waste landfill alternatives, several of which leverage Black Soldier Fly larvae to upcycle organic wastes into high end products.

05

Inseco is an insect protein company providing the food value chain with a cost-effective landfill alternative, whilst also providing the animal feed and pet food industry with a consistent supply of high quality protein.

06

BSF processing of organic waste's potential impact on Cape Town's economy is significant in ensuring that Cape Town has an efficient, resilient and competitive food system.

07

There are clear economic, environmental and business benefits in use BSF larvae to upcycle food waste.

The case study discusses:

- Diverting food waste from landfills;
- Upcycling food waste into high value products;
- Reducing disposal overheads;
- Reducing disposal liabilities;
- Facilitating a resilient food system.

It is written for:

- Businesses disposing of food waste to landfill;
- Animal feed brands / producers;
- Food brands looking to strengthen corporate image.

2 Purpose

A circular economy keeps products, components, and materials at their highest use and / or value for as long as possible. This includes biological nutrients embedded in food. When food waste prevention and surplus food recovery are not possible, landfill diversion for beneficiation needs to be a priority. In addition to being a societal and environmental imperative, it is a strategic business choice to increase competitiveness.

Circular Economy Elements / Strategies

CORE ELEMENTS



Use waste as a resource



Preserve and extend what's already made



Strengthen and advance knowledge



Rethink the business model



Collaborate to create joint value

ENABLING ELEMENTS



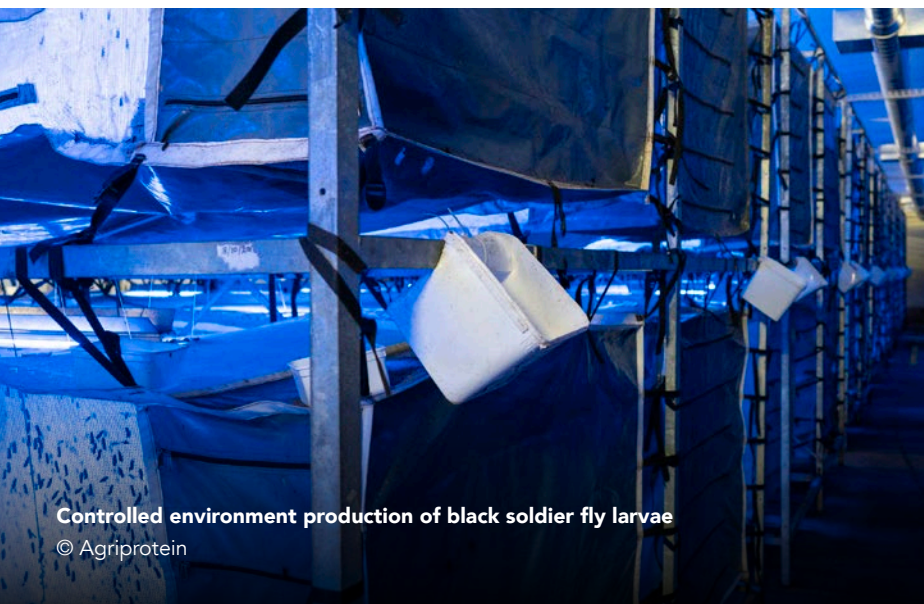
Black soldier fly factory at Agriprotein.

© Agriprotein

Black Soldier Fly (BSF) farming provides a technology for converting food waste into high value animal feed and related products, for which the global demand is increasing. This technology leverages the insatiable appetite of BSF larvae to upcycle organic material into high-end products. These products have various applications notably in the animal feed, pet food, crop production, cosmetics and, pharmaceuticals sectors, and more applications are continually being investigated.

The number of companies in South Africa that are utilising BSF farming is increasing. Inseco is one of the newly established Cape Town businesses and a pioneer of BSF farming technology. Inseco has developed a truly circular solution to organic waste that has business and wider environmental and social benefit.

This case study is written for organic waste generators along the food value chain, a value chain known for considerable loss and wastage, to illustrate how circularity is a useful lens through which to imbue resilience in the food supply chain. Beneficiating organic waste is one of many circularity activities the food and beverage sector can use to alleviate pressures on the overall system. Organic waste beneficiation will reduce landfill disposal liabilities and strengthen competitiveness, which in turn contributes to building more resilient businesses and more resilient cities.



Controlled environment production of black soldier fly larvae

© Agriprotein



Black soldier fly larvae

© Agriprotein

Source: www.circle-economy.com/circular-economy/key-elements



The value chain for the upcycling of food waste provides a range of decent, dignified job opportunities.

© GreenCape

3 Background and Problem

Almost a third (30.8%) of annual global edible food production is lost or wasted: 13.8% takes place at farm and post-harvest¹, whilst 17% takes place from distribution to consumer². South Africa fairs worse with ~45.4% of the ~22.8 million tonnes of edible food never eaten³. Almost three quarters of loss and waste in South Africa takes place from processing to consumer. These stages are associated with cities. Food waste makes up a large proportion of landfilled waste. An estimated 14.5% of the City of Cape Town's (CCT) landfilled waste consists of food waste, whilst an additional 6% consists of residual organics, likely food related. Continued disposal of food related waste to landfill negatively impact on the competitiveness of businesses and the cities that support them. This is due to a number of reasons including:

Costly overhead: Disposing of waste to landfill is a costly overhead. To recover the costs associated with providing waste management services, municipalities must charge tariffs. The CCT charges higher landfill gate fees than other South African metros. The CCT also charges a high bin collection tariff to businesses using its collection service. Private waste collection is equally costly.

Disposal liability: South Africa's cities are running out of safe places to dispose of waste. Siting new landfills is difficult, as there is a risk of infringing on communities and sensitive ecosystems. It is also expensive to construct compliant facilities, to maintain them whilst operational, and to manage them at end of life. Hence landfills are built further away, adding to the waste transport costs which in turn are passed onto the waste generator, such as businesses. In the absence of significant interventions by all stakeholders to divert waste, there is a risk that cities may run short of landfill capacity or "airspace". Cape Town, for example, may run short of airspace as early as 2032.

Climate change liability: When organic waste enters the anaerobic environment present in landfills, methane is produced. Methane is a potent greenhouse gas (GHG) that has historically resulted in the waste sector being responsible for 10–11% of Cape Town's GHG emissions⁴.

Risk of legislative non-compliance: Risk of legislative non-compliance: Due to pollution and climate change impacts of landfilled organic waste, the Western Cape provincial authorities have implemented an organic waste diversion plan that requires Western Cape based landfills to restrict the disposal of organic waste at landfills by 50% by 2022 and 100% by 2027. The CCT is investigating measures to facilitate this diversion and organic waste generators' options to landfill their waste will be progressively limited.

Corporate image liability: Target 12.3 of the Sustainable Development Goals includes a commitment to, by 2030, halve per capita global food waste at the retail and consumer levels. This goal, as well as various numerous media publications and information has contributed to raising the public and investors awareness of food waste's impacts on the environment, and the more sustainable options to manage it. This is putting pressure on brands, especially those marketing sustainability, to internalise food loss and waste commitments, and to extend these commitments to their supply chains. Not adhering to these commitments means food brands / suppliers run the risk of losing customers, investors, clients and their positive corporate sustainability image.

Food production is needed, but the question is how do we produce food in a more efficient manner, and reduce food waste to landfill at the same time. A solution is needed that upcycles low grade food waste into high value products that can be produced within cities and close to the market, and also facilitate regeneration of ecosystems within the food production system.

¹UNEP (2021) www.unep.org/resources/report/unep-food-waste-index-report-2021 www.nature.com/articles/s41893-019-0293-3

²FAO (2019) - www.fao.org/3/ca6030en/ca6030en.pdf

³CSIR (2021) - www.wasteroadmap.co.za/wp-content/uploads/2021/06/17-CSIR-Final_Technical-report_Food-waste.pdf

⁴CCT (2021) - https://resource.capetown.gov.za/documentcentre/Documents/City%20strategies,%20plans%20and%20frameworks/Climate_Change_Strategy.pdf



Insect meal manufactured by Inseco
© Inseco

4 Solution

When all options of food waste prevention are exhausted, it is imperative that food waste is diverted from landfill. Fortunately, Cape Town hosts a diverse number of cost effective landfill alternatives, several of which leverage BSF larvae to upcycle organic wastes into high end products:

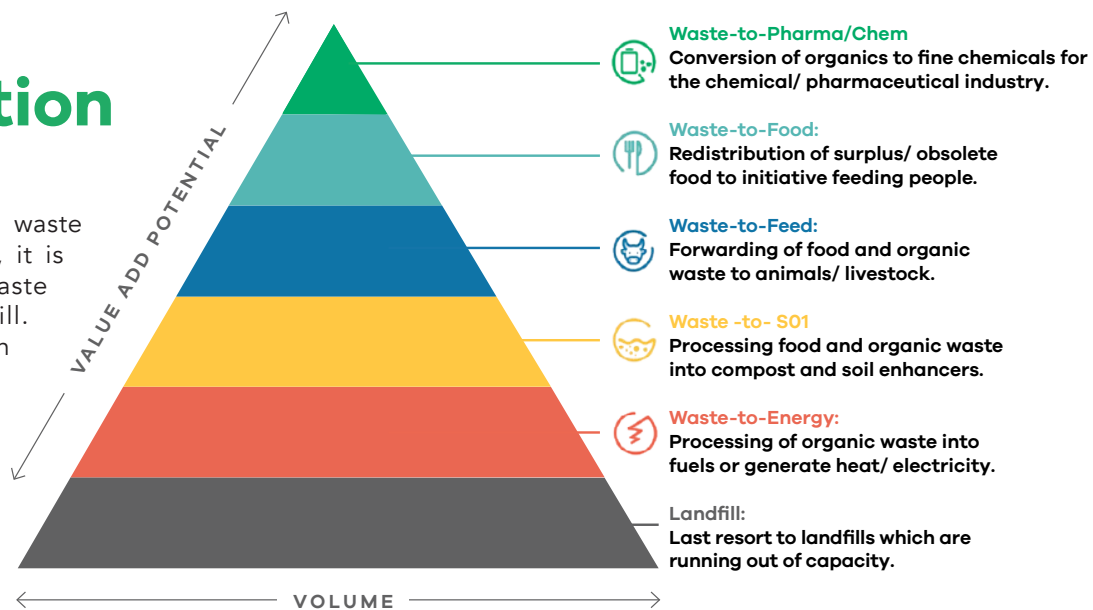


Figure1: Food waste value add heuristic



Inseco factory
© Inseco

Meal: is defatted larvae that are dried and milled into a high quality protein meal. It serves as an alternative to wild fish caught and soy based protein feeds. It is extremely digestible, hypoallergenic, antimicrobial and anti-inflammatory.

Oil: a high quality oil extracted and purified during the meal preparation. It is rich in lauric acid, a medium chain triglyceride that has a number of pharmaceutical, food / feed applications; and provides an alternative to less sustainable oils from wild fish, coconut and palm oil.

Grubs: dried insect larvae high in protein, oils, and calcium. It serves as an ideal poultry, aquaculture, reptile, and bird feed.

Soil: an organic fertiliser consisting of a mix of excreta, insect exoskeletons, and food residues. It can serve as a replacement to fossil fuel based chemical fertilisers.

Chitin: extracted larvae exoskeleton. It has a wide array of applications ranging from pharmaceuticals and cosmetics to animal feed and human food. Chitin boosts healthy gut bacteria and suppress inflammation.

Inseco: is one of a handful of Cape Town's insect protein companies providing the food value chain with a cost-effective landfill alternative, whilst also providing the animal feed and pet food industry with a consistent supply of high quality protein. They are able to provide this protein at a stable, and more competitive price than traditional protein sources, such as soy and fish meal.

Inseco's Philippi facility: combines cutting edge technology with millions of years of evolution to deliver one of Cape Town's largest, and most innovative organic waste solutions. The facility processes a wide range of organic streams – from agricultural residues and industrial by-products to both commercial and hospitality food waste. In the short term, the facility will process 40 tonnes a day of organic waste, before scaling to 60 tonnes in the medium term, and 100 tonnes per day in the long term.



Black soldier fly larvae
© Inseco

The Black Soldier Fly (*Hermetia illucens*) is a wasp looking fly. The adult is shy and avoids human interactions. It does not have mouthparts and thus does not seek out food. The purpose of the adult form is to locate mates and lay eggs. Thus, they are not associated with transmitting diseases, as is the case of the common housefly. Only in the larvae form do they consume food. The larvae digest / converts organics into, amongst others, protein. They have a more efficient feed conversion ratio compared to other protein sources. They have evolved to break down problematic bacteria and emit odours that repel pests. The excrement is rich in nutrients and can be used as a fertiliser. Overall, the BSF is regarded not as a pest, but as a sanitary solution to food waste and a source of sustainable protein.

Inseco's waste management partners supply the urban insect farm with organic waste from their clients. This waste is fed into an industrial scale de-packaging plant and processed into a clean slurry. The slurry is inoculated with millions of BSF eggs and left to hatch and feed off the slurry. Inseco deploys controlled environment technologies to optimise and standardise growth, and after several days, the larvae are processed into its high end products:

By combining food waste upcycling with urban controlled environment agriculture techniques, Inseco is closing the loop on Cape Town's food system. And in so doing, supporting in a more sustainable, more resilient, and more circular Cape Town.

For more information on Inseco please visit www.inseco.co.za.

5 Impact / Outcome

BSF processing of organic waste's potential impact on Cape Town's economy is significant in ensuring that Cape Town has an efficient, resilient and competitive food system. Below is the impact Inseco is forecasted to make for 2022 based on its first six months of operation:

Economic Benefits

Localise production: Inseco produces quality protein within Cape Town's urban edge, thus replacing riskier imports of soy-based protein and wild fish based protein.

Reduce consumption: Inseco uses food waste to produce protein that replaces wild fish and soy protein; and, reduces the need for antibiotics, and replaces fertilisers.

Extend landfill airspace: of the ~9,300 tonnes of food waste expected to be processed per year, ~7,200 tonnes is likely destined for landfill. This equates to ~5 760m³ of landfill airspace unlocked to accommodate problematic waste streams.

Extract value: between R3 500 – R4 000 is extracted from one tonne of input food waste. In total, Inseco is expected to add an additional R30 – R40 million worth of product into the economy per year.

Created jobs: When operating at full scale, Inseco will employ 72 full time staff: 8 low-skilled, 54 semi-skilled, and 10 skilled staff.

Enabling land efficient protein: Inseco is able to produce 7.5 tonnes of insect protein per year from 1m² of already transformed urban land that is close to its feedstock.

Upcycle organic waste: Inseco's larvae are able to quickly and efficiently convert low grade organic waste into a high value protein meal and bioavailable fertiliser.

Food security: BSF protein increases the diversity of local protein supply that is not susceptible to zoonotic diseases. Although BSF protein enters the human food chain indirectly as animal feed, it may one day enter human diets in a direct way, thus increasing the local food supply in cities and consequently also free up food that would be used to feed livestock.

Support innovation: Inseco forms part of a growing ecosystem of Cape Town based BSF solutions, thus making Cape Town one of the global hubs for BSF innovation.

Business Benefits

Reduce future disposal liability: Inseco adds to Cape Town's diverse mix of food waste solutions that business can use to meet a 2027 provincial organic waste diversion from landfill requirement.

Provide landfill cost savings: Inseco charges a lower gate fee than landfill disposal. Inseco is expected to save Cape Town companies between R2.5 million - R3.0 million in landfill gate fee savings per year.

Unlock a revenue stream: Inseco is able to pay, depending on type and quality, for waste streams. In total, Inseco expects to pay between R0.7 million – R2 million in rebates.

Enable corporate social responsibility: Inseco provides a means to meet food loss and waste reduction commitments made by South Africa's food brands, but also to integrate more sustainable ingredients into the supply chains of these brands.

Environment Benefits

Reduces GHG emissions: Inseco is expected to save 15 000 - 17 000 tonnes of GHG emissions a year compared to landfill.

Replace chemical fertilisers: Inseco will produce 2 000 – 2 200 tonnes of non-fossil fuel based organic fertiliser that supports not only plant health, but a healthy soil too.

Support biodiversity: One tonne of BSF protein meal can replace five tonnes of wild fish⁵. Inseco will replace the equivalent of 1 500 – 1 800 tonnes of wild fish per year. BSF protein also displaces soy protein, a major driver of deforestation. Insect protein may one day replace livestock as a source of protein for human consumption. This will reduce the vast tracks of land needed to raise livestock and produce feed, often land that encroaches on sensitive ecosystems.

⁵ IFFO (2009) www.iffco.com/system/files/downloads/EAS%20FIFO%20September2009%202_0.pdf



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