GreenCape

INDUSTRY BRIEF

Black Soldier Fly agriculture

Upcycling Cape Town's organic waste into local, climate friendly, and resilient feed for livestock, pets and the soil

Main insights

1. There is a need for resilient food supply chains both globally and locally.
2. Most of South Africa's municipalities have run out of, or are running out of, landfill airspace.
3. Circular economy principles can help futureproof against a range of challenges related to climate change, food security and ecosystem degradation.
4. Black soldier fly (BSF) turn organic waste disposal liabilities into economic opportunities.
5. Major opportunities relate to waste minimisation, animal feed, and soil security.
6. Cape Town is the epicentre of the BSF innovation in South Africa, but also a global leader.
7. BSF is one solution to ensure the Western Cape's 2027 organic waste landfill ban is achieved.

1 Introduction

The planet has entered the decade of polycrises[1], where climate instability, ecosystem pressures, and geopolitical tensions are expected to exacerbate an already fragile food supply chain. Such crises provide an ideal opportunity for innovation and future proofing. One way to achieve this is through the implementations of circular economy principles.

A circular economy keeps products, components, and materials at their highest use and / or value for as long as possible. This includes the biological nutrients embedded in animal feed and human food.

When food waste prevention and retention are not possible, beneficiation must be a priority. This is not only a societal and environmental imperative, but a strategic business decision to enhance resilience and remain relevant and competitive.

One solution that can assist in unlocking the circular economy is the Black Soldier Fly (BSF).

In natural ecosystems, insects play a number of pivotal roles including as pollinators and in predator/prey interactions for a wide spectrum of organisms. Many insects, including the BSF, also act as waste processors, and convert organic material into body mass and nutrient rich excrement. In so doing, they keep nutrients cycling indefinitely within their ecosystem.

By combing modern technology, a number of Cape Town based innovators are leveraging the insatiable appetite of the BSF larvae to upcycle low-value organic waste into high-value products. Products that have a wide array of applications, most notably in animal feed and pet food, but also for crop production and healthy soils to feed the food that feeds humans.

This industry brief covers the role BSF play in fostering a regenerative but competitive food system. The brief also introduces the reader to the state of Cape Town's thriving BSF sector, and illustrates the opportunities that exist for this sector, notably to keep organic waste out of landfills, future proof animal feed supply, and future proof healthy soils.

This industry brief is written for:

1. Financiers seeking investment opportunities.
2. Brands looking to future proof supply chains.
3. Regulators looking to support jobs and investment.

The industry brief discusses:

Role of BSF in future proofing Cape Town.

State of Cape Town's current BSF sector.

The opportunities for growth.

Enablers and barriers of this growth.

Recommendations to overcome the barriers.

2 Background

Almost a third (31%) of annual global edible food production is lost or wasted: 14% takes place at farm and post-harvest, whilst 17% takes place from distribution to consumer. South Africa fairs worse with ~45% of the ~22.8 million tonnes of edible food never eaten.

Almost half (49%) of loss and waste in South Africa takes place during the processing and manufacturing. This wastage is a symptom of what has become known as a linear economy.

However, wastage is only one symptom of a take-make-dispose economy. Food production requires:

- Significant input of resources, much of which are traded and transported on a global market;
- Large swaths of land, much of which infringes on sensitive ecosystems; and
- Is a major driver of climate change, both during production and when landfilled.

ALMOST A THIRD (31%)

of annual global edible food production is lost or wasted: 14% takes place at farm and post-harvest, whilst 17% takes place from distribution to consumer.

The ecological, social, and economic shortfalls of such a system are well documented[2], and exposes nations, cities, and their citizens, to chronic stresses and acute shocks. In general, these impacts are amplified when animals are included along the food supply chain. Much of this amplification can be attributed to growing the food that feeds the food that feeds humans.

This has all been to service the needs of a growing population, which reached 8 billion in 2022.[3] It is estimate that humans account for ~34% of all the mammalian biomass on Earth. Wild animals make up only 4%. Whilst livestock and pets make up the vast majority (~62%), of the world's mammal biomass. As for birds, poultry makes up 71% of global bird mass[4].

The disparity between wild animals and livestock is expected to increase. Not only because the world's population is projected to increase to 9.7 billion by 2050[5], but because of a growing middle class. This increase in population and purchasing power will increase the demand for animal based products and services, notably as a source of protein and for companionship, is expected to increase. Animal-based products are expected to rise year on year, with demand for meat products alone expected to increase by 327% in Sub-Saharan Africa by 2050[6]. It is estimated that the global growth in demand for companionship animals, like cats and dogs, will also rise (notably in developing countries[7]).

Amidst these concerns, it is recognised that animals, and their associated services and products, will continue to play an integral part globally and in South Africa's cuisine, cultural landscape and livelihoods, and demand for animal based products and service will remain strong as population and spending power increase. It is thus important to ensure that animal protein produced is done so sustainably, with circularity being a guiding principle.

The food system is confronted with two major incentives:

1. Minimise the ecological footprint; whilst

2. maximising food security.

This is driving the interest in sustainable and novel feeds to displace conventional and traditionally riskier, sources (e.g. fishmeal or soybean meal) for use in farmed animal feed, notably poultry, pigs, salmon and pets. This includes a wide range of "novel feed protein" sources, such as: seaweed and microalgae, plant proteins, and microbial proteins (e.g. bacteria, fungi, and algae).

Another novel feed protein source that is growing international recognition by activists, policy makers, investors and brands is insect based protein.

3 The Black Soldier Fly

The BSF (*Hermetia illucens*) has a complex life cycle which includes five major stages over 39 – 47 days:

1 egg 2 larval 3 pre-pupal 4 pupal 5 adult fly

BSF are native to South America, but have become widespread and virtually cosmopolitan, including within South Africa and are not regarded as invasive. They are also not regarded as pests or vectors of disease. This is largely because the mobile adult is shy and generally avoids human interactions. Furthermore, the adult does not have mouthparts and thus does not feed. The sole purpose of the adult form is to locate mates and lay eggs.

It is only in larval form that seek out food. The BSF larvae has a low / more efficient feed conversion ratio of 1.4 - 2.6 – meaning for every 1kg of insect protein, 1.4 - 2.6kgs of feed is required. The larvae have also evolved to break down problematic bacteria and emit odours that repel pests. Once the larvae have consumed enough nutrients, they pupate and prepare for metamorphosis into an adult fly.

BSF farmers are able to treat a wide range of organic waste streams, ranging from CAPEX intense industrial scale centralised facilities equipped with artificial intelligence (AI) and automation, to cheap labour intense decentralised containerised operations, by feeding the material to BSF grubs, and subsequently process the pre-pupae and its excrement into a number of high value products.

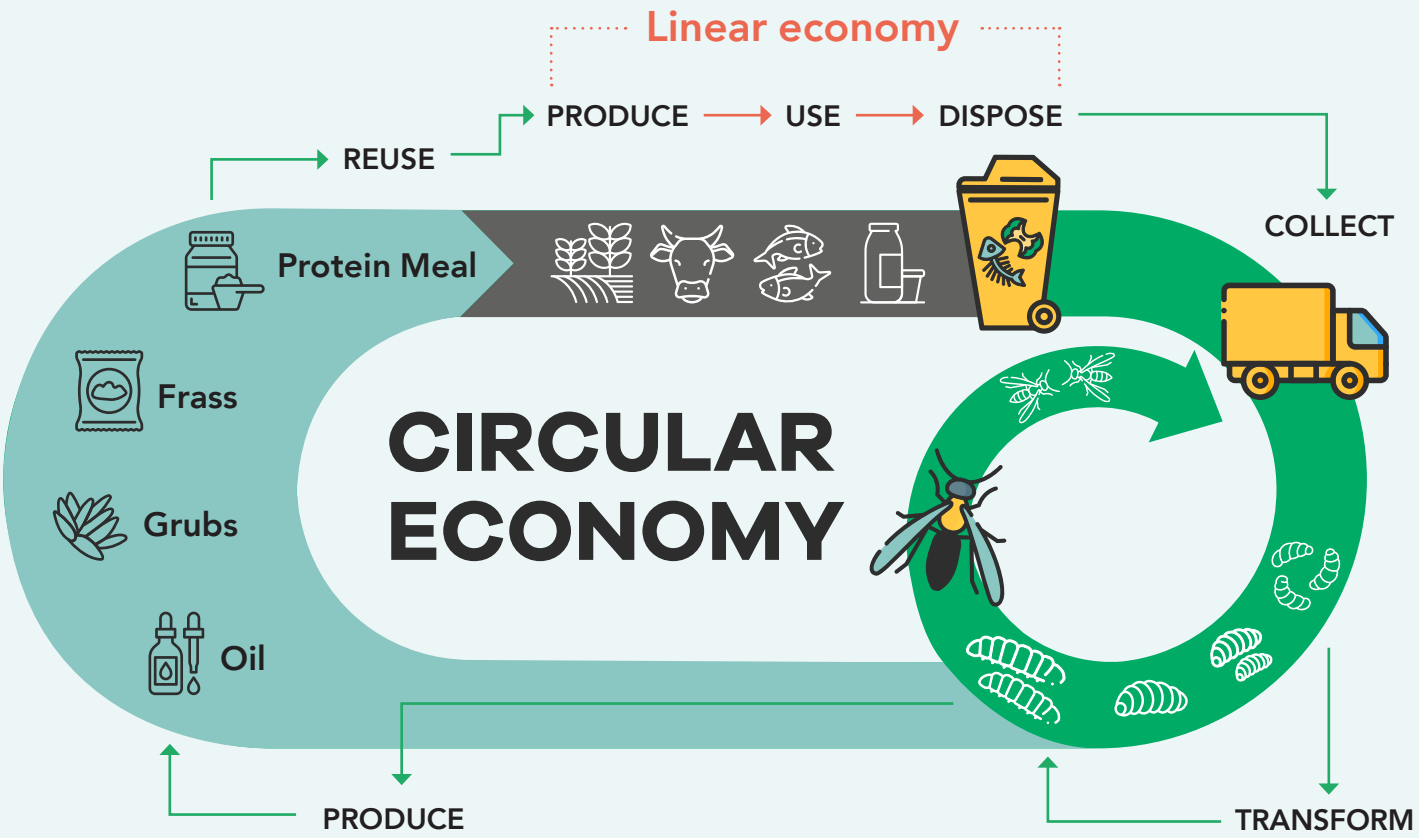


Figure 1: BSF circular economy graphic (adapted from Future Green Solutions)

Source: Adapted from WWF (2022)

Grubs: Dried or frozen pre-pupae, that combine the benefits of protein, lipids, and chitin. They can serve as an ideal feed or feed ingredient for monogastric animals.[8]

Protein meal: Defatted pre-pupae that is dried and milled into a balanced meal. Amino acid profile means that the meal can serve as a more than adequate protein alternative to wild fish and soybean based protein sources for feed or feed ingredient for monogastric animals.

- Contains all essential amino acids required for animal nutrition.
- Rich in vitamins and minerals, including calcium, iron, magnesium, sodium, zinc, and potassium.
- Contains 56 - 82% protein[9], and up to double soybean meal, and in excess of hi-pro soymeal and fishmeal.
- Highly digestible, hypoallergenic, antimicrobial and anti-inflammatory.
- Antimicrobial peptides increase resilience against bacterial infection.

Oil: High quality oil extracted and purified during the protein meal preparation. It is serves as an alternative to less sustainable oils such as wild fish, coconut and palm oil.

- Rich source of energy.
- Rich in essential fatty acids, notably Omega-3.
- Rich in fatty acids notably: lauric, palmitic, oleic, and linoleic acids.
- Mostly lauric acid, a medium-chain fatty acid that has antimicrobial and anti-inflammatory properties.

Frass: A soil ameliorant and bio-stimulant consisting of excreta, insect exoskeletons, and food residues. Serves as an alternative to fossil fuel based chemical fertilisers, but also foster healthy soils.

- Can be rich in nitrogen, phosphorus and potassium (NPK).
- Good cation exchange capacity means slow release organic fertiliser.
- Rich in microbial diversity, and low pathogen count.
- Bio-stimulant that promotes growth.
- Boosts natural defences against fungi, insects, bacteria and viruses.
- High carbon content increases water holding capacity.
- High carbon sequestration for potential carbon credit opportunities.

Overall, BSFs are regarded not as pests, but as a sanitary solution to organic waste, and a source of sustainable feed and healthy soils. Compared to traditional protein sources, BSF based protein meal for feed is regarded as a more sustainable alternative. **Table 1** provides a broad impacts comparison between soybean, wild fish caught meal, and insect based protein.

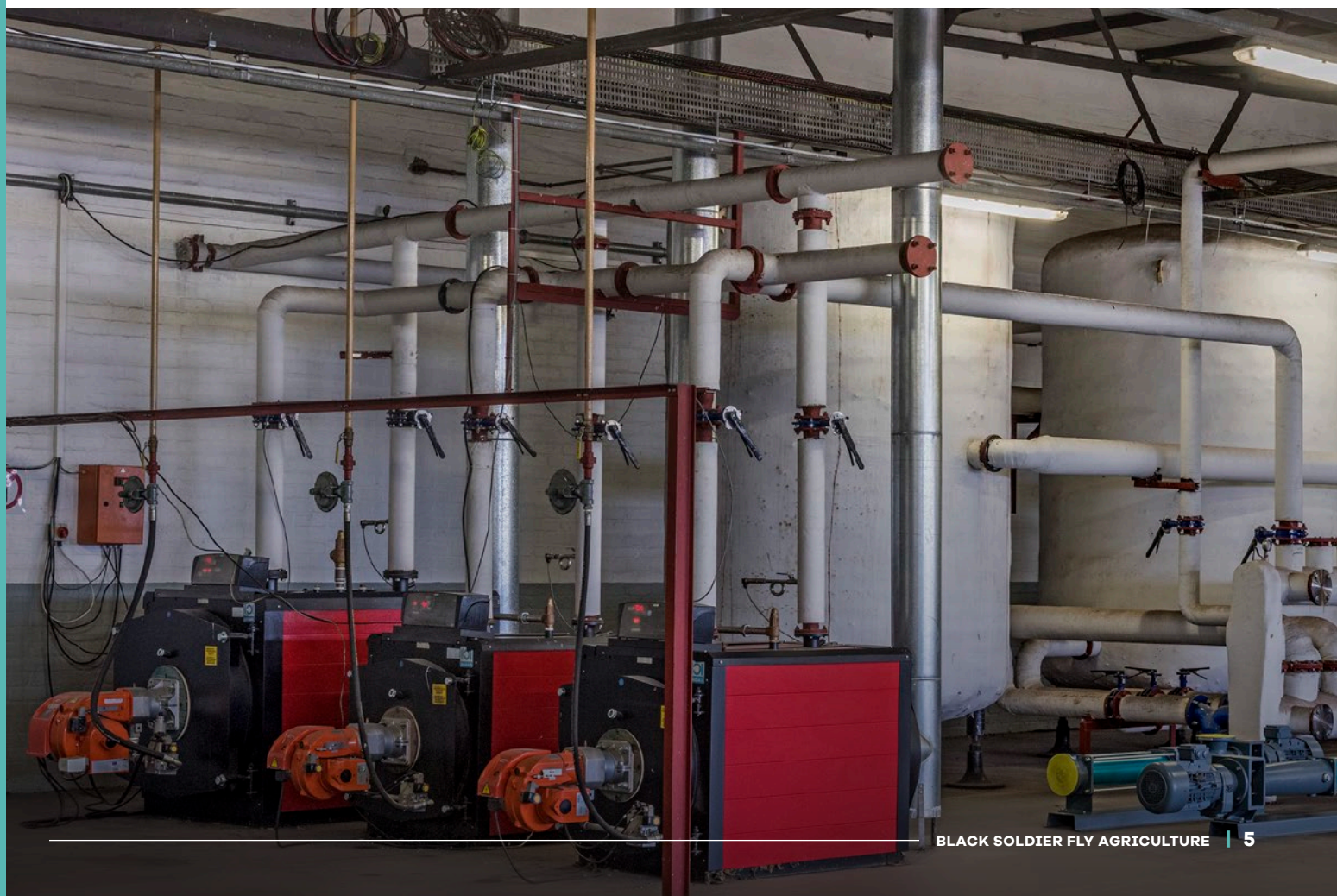


Table 1: Broad environmental impact comparison between soybean, wild fish, and insect protein meal for the UK

IMPACTS		SOYBEAN	WILD FISH	INSECT
State indicators (changes to state of nature)				
Land use change		High conversion risk	No impact	No land use change at scale
Soil condition		Intensitve agriculture	No impact	No impact
Climate impact		Conversion	Relatively low emissions from shipping	Operation of facility
Water removed		If irrigated	Low impact	Operation of facility and substrate moisture adaption
Nitrogen		If N fertilizer is applied to soy or to through crop rotation	No impact	Nitrogen accumulation in frass
Biodiversity		Conversion and intensive agriculture	Reduced fish stocks and bycatch	Low ecological impact
Pollution		Pesticide used and eutrophication	Effluent discharge	Limited evidence
Waste		Limited evidence	Limited evidence	By-products chitin and frass have uses and growing market
Pressure indicators (environmntal footprint assessment)				
Land use footprint		Large area required	Small area used	Small area used
Carbon footprint	**Direct**	Cultivation and shipping	Fishing vessels	Heating requirement
	Indirect	Land use change	Low indirect footprint	Substrate dependent
Water footprint		High water use	Limited evidence	Low water use

Source: Adapted from WWF (2022)

Red = high impact **Yellow = medium impact** **Green = low impact** **Blue = no impact**

4 Current status of BSF farming in Cape Town

Cape Town is regarded as the epicentre of South Africa's BSF industry, and a global hub for innovators. In 2015, Cape Town made global headlines when AgriProtein established the world's first industrial scale insect rearing and processing facility. In 2021, AgriProtein closed its South African operations, but a number of companies carried on, and new companies have been, or in the process of being, established in Cape Town and surroundings:

- AgriSect
- Amesect
- BSF Breeding
- GenBioSol
- Inseco
- Maltento
- Nutrisek
- Nutrient Loop

Annexure 1 provides a short introduction to each BSF companies and what stage of funding they are at. **Figure 2** illustrates an aggregated summary of the processing capacity, including input and output, of these BSF companies in the current, short, medium and long term.

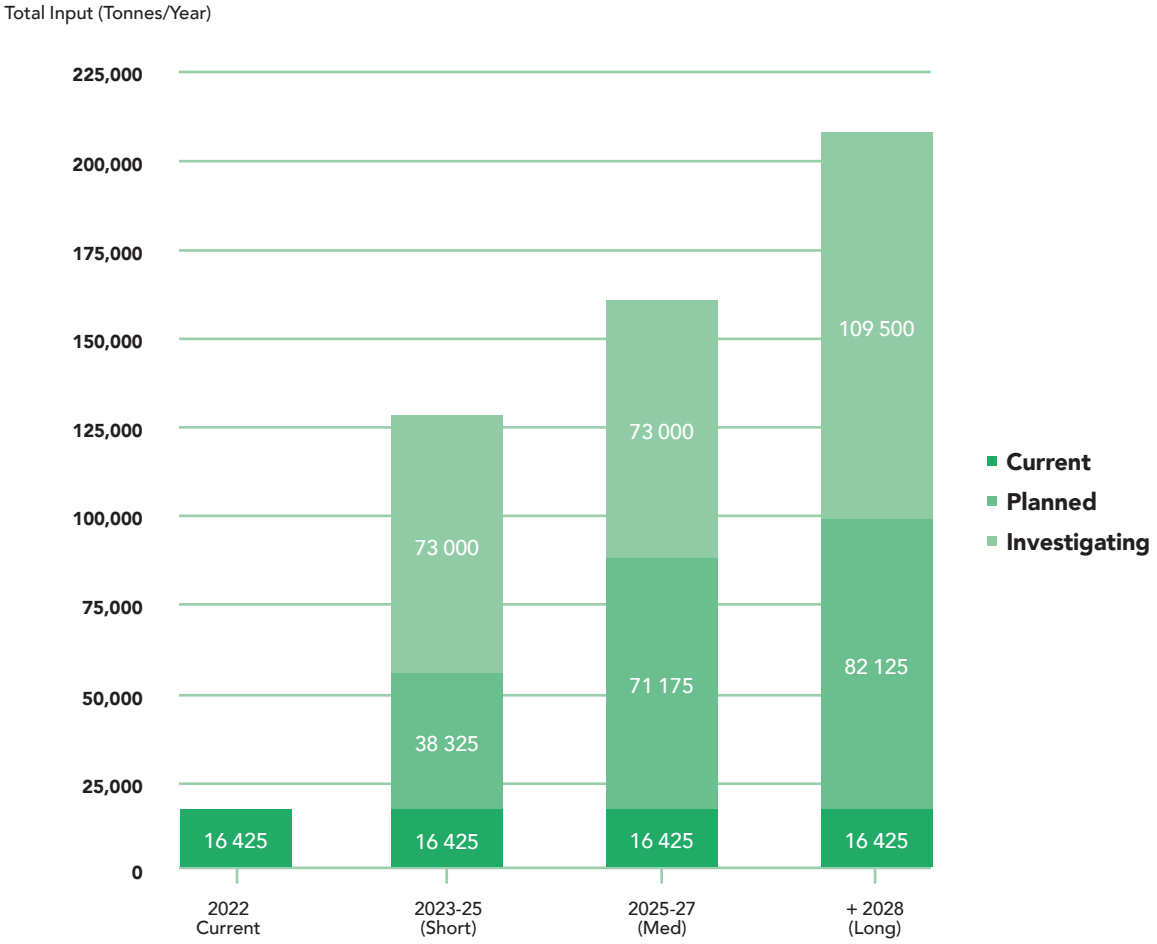
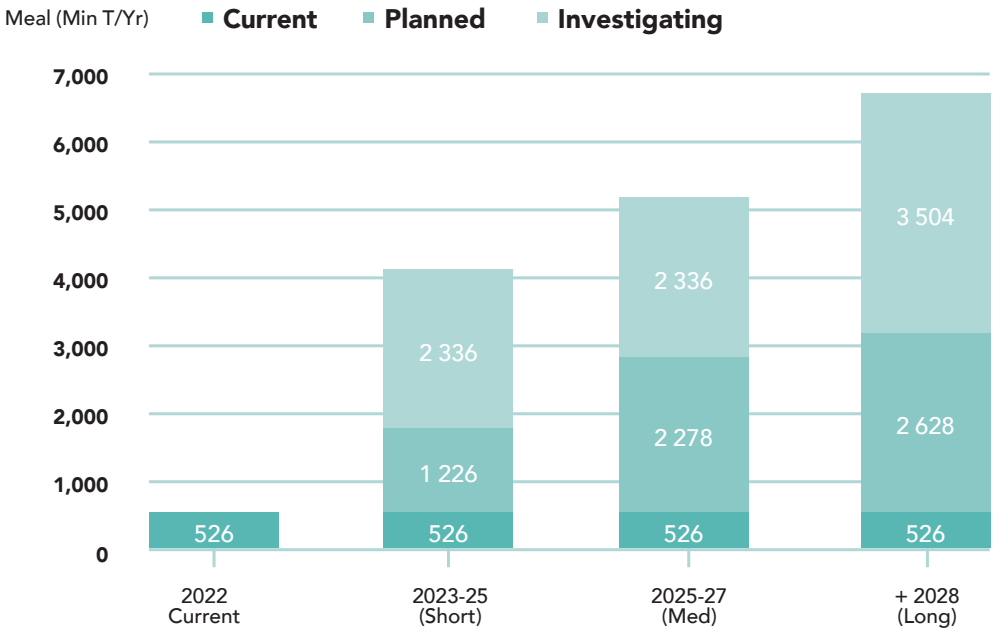
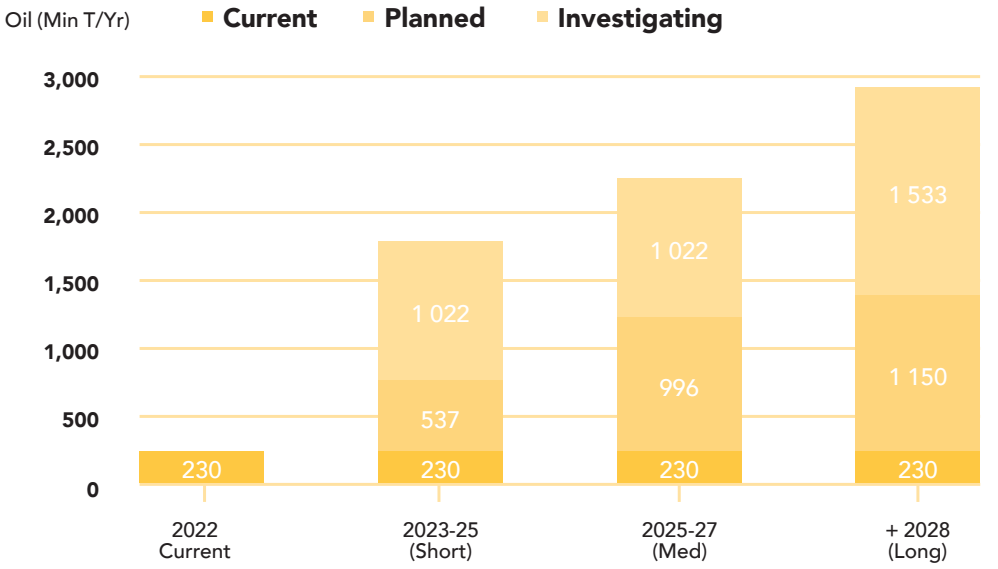


Figure 1: Summary of current and potential future processing capacity of BSF companies in Cape Town
Source: Industry engagements





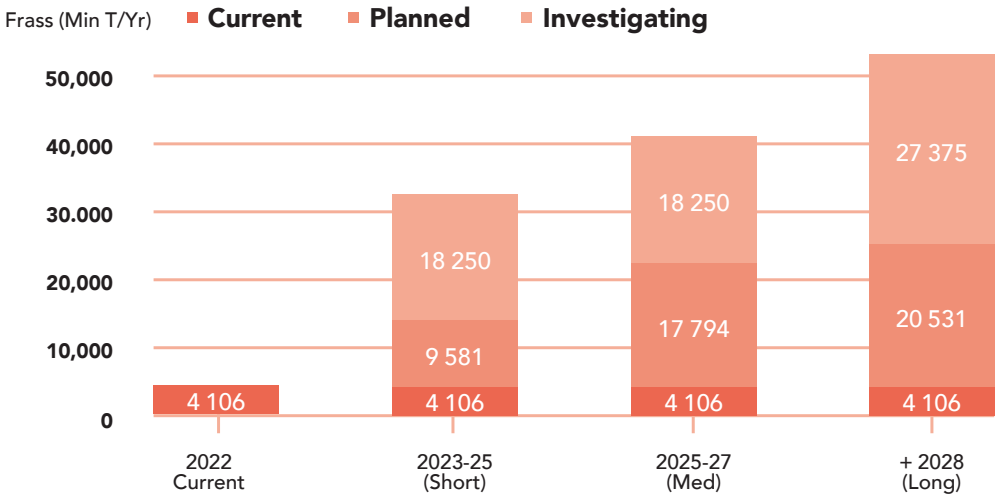


Figure 2 continued: Summary of current and potential future processing capacity of BSF companies in Cape Town
Source: Industry engagements

Several major global investments have been made in BSF over the last several years, as illustrated in **Table 2**. Whilst the sector is growing in South Africa, the growth of the industry is lagging behind more developed economies. In these countries, considerable public and private investments have been made, and have, or are in the process of, reforming key legislation to unlock insect nuance.

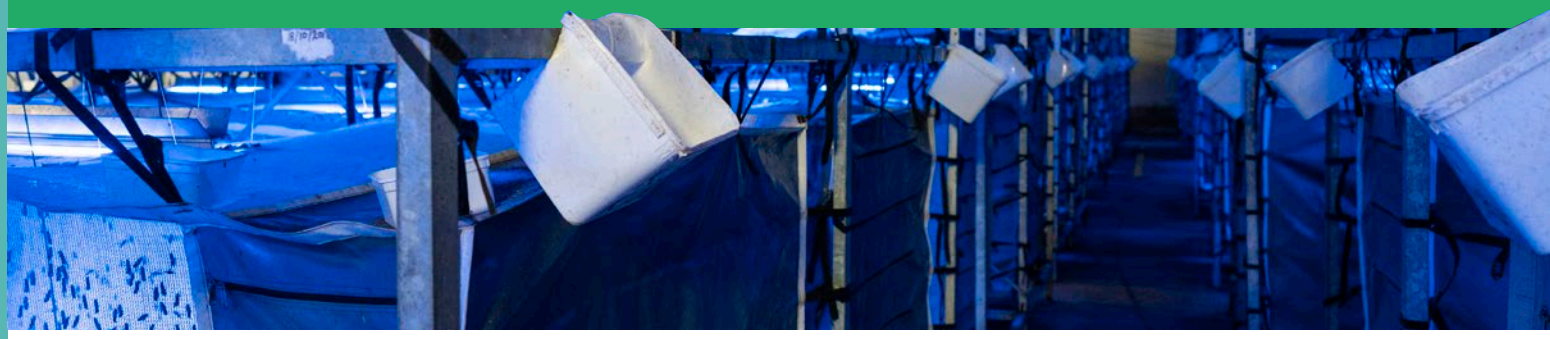
Table 2: Major investment made in global BSF companies

COMPANY	REGION	AMOUNT	ROUND	DATE
Maltento	South Africa	$3.3m	Seed	2023
Entocycle	United Kingdom	$5m	Series A	2023
Inseco	South Africa	$5m	Seed	2022
Next Protein	Tunisia	$11m	Series A	2020
Better Origin	United Kingdom	$16m	Series A	2022
Nutrition Technologies	Singapore	$20m	Series A	2022
Protix	Netherlands	$57m	Since 2009	
Innova	France	$400m	Since 2016	
According to the IPIFF, over €1.5 billion has been invested into insect agriculture by its members.				

5 The opportunities

The era of globalisation, as we knew it, is over, and a decade of polycrises[10] is upon us. Such a decade is expected to see a number of crisis, notably related to the environment and geopolitical strife. This should disrupt supply constraints and price volatility for various goods and services, most notably food and animal feed. Such unstable conditions provide an ideal opportunity for innovation for future proofing. Future proofing is achievable through the circular economy principles, and nowhere is this better exemplified than through BSF.

Figure 3 provides a summary of the potential value of to be unlocked through BSF treatment, compared to other organic waste solutions; whilst **Table 3** summarises the opportunities for integrating BSF into a more circular food system. The opportunities will be discussed further.



TECHNOLOGY	VALUE ADD POTENTIAL (R/TONNE ORGANICS)
	MINIMUM - MAXIMUM
Soil/Compost	R75 - R1 980[25]
Biogas	R48 - R726
Black Soldier Fly	R2 028 - R10 170

COMPOST

1. CCT organics:
R23m - R596m

2. Private organics:
R6m - R165m

3. SBM organics:
R3m - R83m

4. CCt sludge
R3m - R70m

BIOGAS

5. CCT organics:
R11m - R161m

6. Private organics:
R3m - R45m

7. SBM organics:
R1m - R22m

8. CCt sludge
R2m - R26m

BLACK SOLDIER FLY

9. CCT organics:
R439m - R2 191m

10. Private organics:
R122m - R608m

11. SBM organics:
R61m - R306m

Figure 3: An opportunities prioritisation matrix for organic waste solutions
Source: Industry engagement

5.1. Waste management opportunity

BSF larvae are hardy, and have evolved to compete in highly hostile environments. This makes BSF larvae an attractive treatment solution to a wide range of organic waste streams from agricultural residues and food waste to human faeces and biogas digestate. The business case of BSF is built on the end market of high value products and less on the gate fee. This strengthens the BSF business case compared to biogas, and composting. In some cases, organic waste is purchased. The City of Cape Town (CCT) sent 160 000 – 225 500 tonnes of food related waste to landfill in 2022 (**Figure 8**). This excluded the unknown organics landfilled at Cape Town's only private landfill, of which ~600 000 tonnes of total waste is landfilled annually.

The diversion of food waste is a major priority for the CCT, the businesses, and the waste companies servicing businesses. This is for a number of reasons, most notably:

Rising cost of landfilling: The CCT has the highest landfill gate fees of any other metro in South Africa. As illustrated by **Figure 4**, this overhead is expected to increase above inflation year-on-year.

Organic waste landfill ban: The Western Cape Department of Environment Affairs, and Development Planning's (**DEADP**) organic waste diversion plan requires all landfills within the Western Cape to not accept organic waste by 2027.

Private sector commitments: A number of South Africa's major brands have committed to food loss and waste targets. External commitments are coordinated by the South African Food Loss and Waste Voluntary Agreement (SAFLWVA)[11], but some companies have internal targets. The above needs and drivers illustrates the short to medium term opportunity to provide to businesses within the Cape region with a cheaper alternative to landfill disposal.

5.2. Livestock feed ingredient

Insects make up natural diets for many birds, reptiles, fish and mammals. Like humans, animals require a balanced diet of macro- and micro-nutrients to grow, but also thrive. Of particular importance are proteins, notably the amino acids, the building blocks of life. Protein requirements vary among animal species. Fish, poultry, and monogastric mammals, notably pigs, cats and dogs, require higher dietary protein relative to ruminant species, who gain much of their amino acids from microbial activity in the rumen (stomach compartment) and from feed proteins that escape ruminal degradation. The protein profiles, notably the essential amino acids, of BSF larvae has shown to be more than adequate replacement to more traditional sources like soybean and wild fish. Insect protein based ingredients can in part or full substitute soybean or fish protein meals. In 2022, ~12 million tonnes of animal feed was consumed in South Africa (**Figure 9**). At least one million tonnes was soybean meal used for protein. At least a third of this (0.34 million tonnes) was imported. A further 14 100 tonnes of wild fish meal was also used.

The fatty acid profile of the BSF larvae makes BSF based oil an ideal ingredient for animal feed too. However, BSF oil should not be compared to other vegetable oils used in livestock feed, but rather as a new, more sustainable ingredient for animal nutrition.

The diversification and localisation of protein sources for animal feed is key to ensuring short and longer food security. This is for a number of reasons, most notably:

Supply risk: South Africa is reliant on soybean based imports for feed, but also heavily reliant on inputs needed to grow the local sources[12]. This creates a supply risk during times supply chain challenges, as have been experienced.Of the ~217 million tonnes of vegetable oil consumed globally in 2022/23, ~88% consists of just four sources: palm oil (36%), soybean oil (28%), rapeseed (canola) oil (15%), and sunflower oil (9%)[13]. This increases the vulnerability of production to the impacts of climate change and specific diseases. Vegetable oil production is concentrated in a few countries: ~84% of palm oil is produced in just Indonesia and Malaysia; ~76% of soybean oil is produced in four countries: China, Brazil, the United States of America, and Argentina. Ukraine and Russia account for ~52% of global sunflower oil production. Although South Africa produces oils, it is still highly reliant on imports.

Price volatility: Even though South Africa grows soya, its growers are competing on the global market, and thus during times of supply chain challenges farmers are likely to sell to higher paying markets. This is reflected by commodity prices (**Figure 5** and **Figure 6**).

Lower impacts: Many brands, notably international brands, are under pressure to reduce the impact of their goods and services on the environment. Considering **Table 1**[14], BSF protein is considered more sustainable that soybean and wild fish caught sources.However, the price of BSF protein compared to soybean and wild caught fish sources is higher (**Figure 6**). At least until the industry matures or the risks of traditional protein are realised. This price is a limiting factor for its uptake in the mass rearing of livestock where small incremental input costs have profound impacts on the profitability when scaled.

BSF protein as a livestock feed ingredient is a medium-to-long term opportunity, but could be a short-to-medium term opportunity if used as a partial substitute to leverage the indirect benefits: supply chain risks, environmental, and functional benefits that have shown to decrease mortality, inflammation, and improved gut health and growth performance.

5.3. Pet food ingredient

In 2020, South Africa was home to ~14.9 million cats and dogs[15]. Of this, an estimated 10.9 million have homes, 0.7 million are housed in shelters, and the remaining 3.4 million are strays, living off the streets. This means that around 15.6 million dogs in South Africa require some form of form pet food.

In 2023 the industry's generated ~$147 billion in revenue. This is expected to grow at a compound annual growth rate (CAGR) of 11% till 2027[16]. The US dominates the market making up $57 billion (40%) in revenue, whilst Europe equates to around $42 billion (28%). South Africa sits at $0.5 billion (0.4%), but is expected to grow 22.8% CAGR till 2027.

In addition to the drivers mentioned regarding the integration of BSF into livestock feed, there are additional drivers that should be considered regarding pet food.

Functionality: Pet owners, and by extension pet food manufactures, want their pets to not only grow, but thrive[17]. This is one of the major drivers in the rising cost of pet food. Noting the functional benefits highlighted in Section 3, BSF ingredients are not only a protein source, but have shown to have a number of beneficial properties that facility healthy animals: BSF meal is highly digestible, hypoallergenic, anti-inflammatory, and supports healthy gut microbiome.

Palatability: Palatability[18] is one of the major considerations for pet food manufacturers looking to differentiate their product. Whilst 'palatants' are added to pet food to increase desirability, the source of protein is a key consideration too. BSF meal has shown to have comparable, and in some cases superior, palatability to traditional protein sources, including plant based ingredients.

Lower Impact: Pet food developers are under pressure from customers and shareholder to develop sustainable products. However, where livestock feed is largely driven by the bottom-line, pet owners are more willing to pay a premium for food that is not only good for pets, but the planet too[16]. Demand for sustainable pet food is growing. Local manufactures are already including insect based ingredients into their: **Nala**, **Aiko**, and notably Bob Martin. The demand is also growing considerably in foreign markets such as the EU, UK, and the US, with Major brands like **Mars Petcare** and **Nestle Purina** have incorporated BSF into their products. The short-to-medium term opportunity is to supply the local and international pet food markets with a sustainable and functional feed ingredient as a replacement or partial replacement to alternative protein sources.

5.4. Soil security

Soil Security: Plants need nutrients to grow and thrive. In natural ecosystems, nutrients are supplied through complex exchanges between various organisms from fungus, bacteria, as well as insects, and their frass. BSF frass has shown to support plant growth but also support and enhance soils in the long term. In 2021, South Africa consumed ~2.2 million tonnes of physical fertilizer products, of which ~0.6 million tonnes was NPK[19]. Figure 10, shows ~75% of South Africa's fertilizer is used to grow just four commodities: Maize, sugarcane, vegetables and wheat.

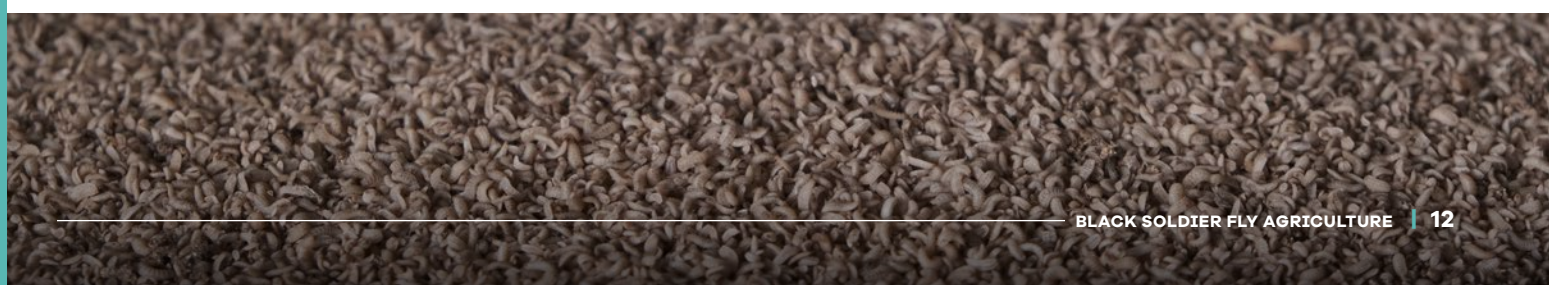
The need to localise and diversify South Africa's fertilizer dependency is driven by a number of key reasons, most notably:

Supply security: South Africa exported ~0.77 million tonnes of fertilizer in 2021, but imported ~2.6 million tonnes. This nett import of 1.8 million tonnes makes up 83% of the total 2.2 million tonnes consumed in 2021. This is a major risk in the event of supply challenges, such as geopolitical tensions.

Price volatility: Supply chain constraints affect prices. Coupled with a weakening rand, farmers ability to weather price volatility illustrated by Figure 5 are proving difficult. South Africa imported 2.23 million tonnes of fertilizer in 2020 at a cost of R8.4 billion. However, South Africa spent R24.8 billion in 2022 for a 2.23 million tonnes[20]. This translates to price volatility along the food supply chain, including animal feed.

Demand for organic: The global, and to some extent local, demand for organic food is on the rise, especially in South Africa's major export markets, such as the US and EU. Local suppliers are under mounting pressure to develop more sustainable products and as such are seeking organic based inputs to replace synthetic fertilizers.

The short and medium term opportunity is to supply local farmers, notably those exporting to organic demanding countries, in full and or in part a replacement to synthetic fertilizers.



At a global level, the BSF market is projected to grow 30.5% CAGR from 2022 to reach $3.96 billion by 2033[21]. In terms of tonnages, this market is expected to grow 36.9% CAGR over the same period to reach 8 million tonnes of product by 2033. This growth is attributed to: rising global meat demand; growth of the aquaculture industry; rising prices of soymeal and fishmeal; and increasing government support.

Companies investigating the export of insect based products to more profitable shores must adhere to the respective regulations of those markets. It is suggested that such companies engage with the respective regional associations listed in **Annexure 1**.

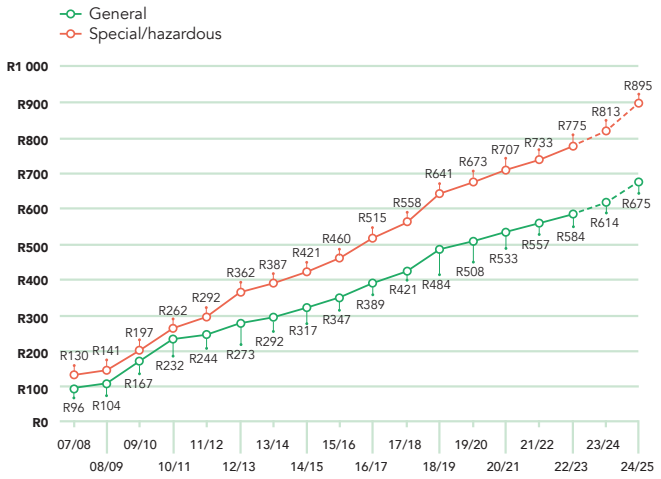


Figure 4: Municipal landfilling fees (excl. VAT) for Cape Town
Source: CCT (2023)

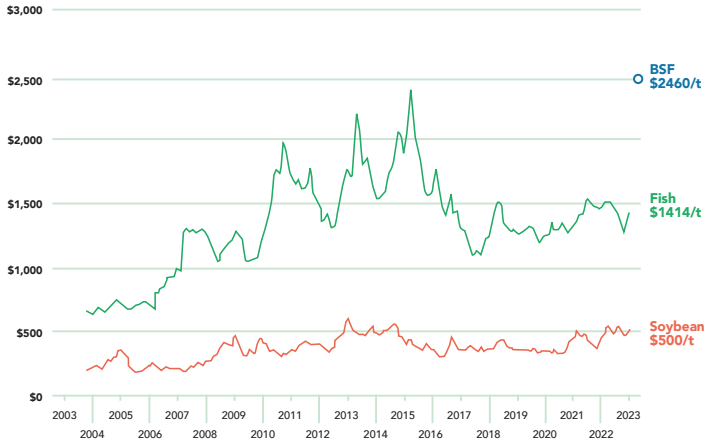


Figure 5: International fishmeal and soybean meal prices
Source: Quantec (2023)

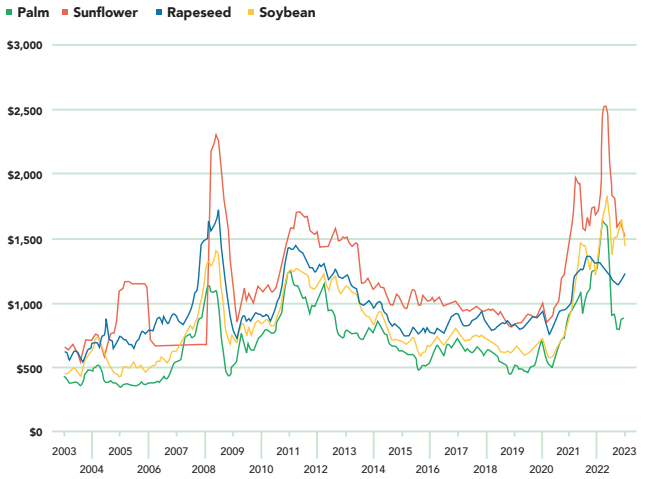


Figure 6: International vegetable oil prices
Source: Quantec (2023)

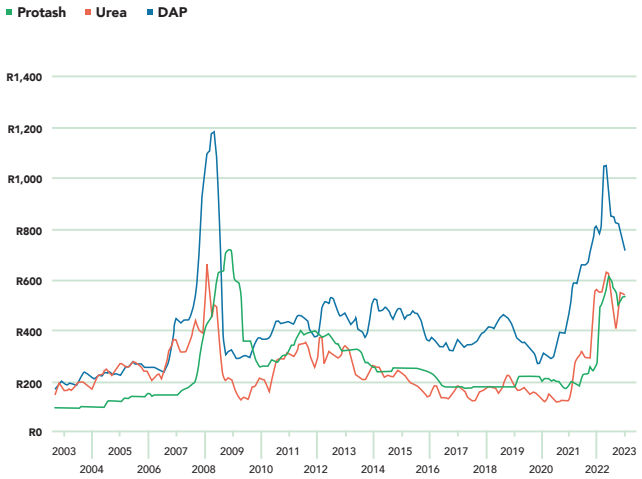
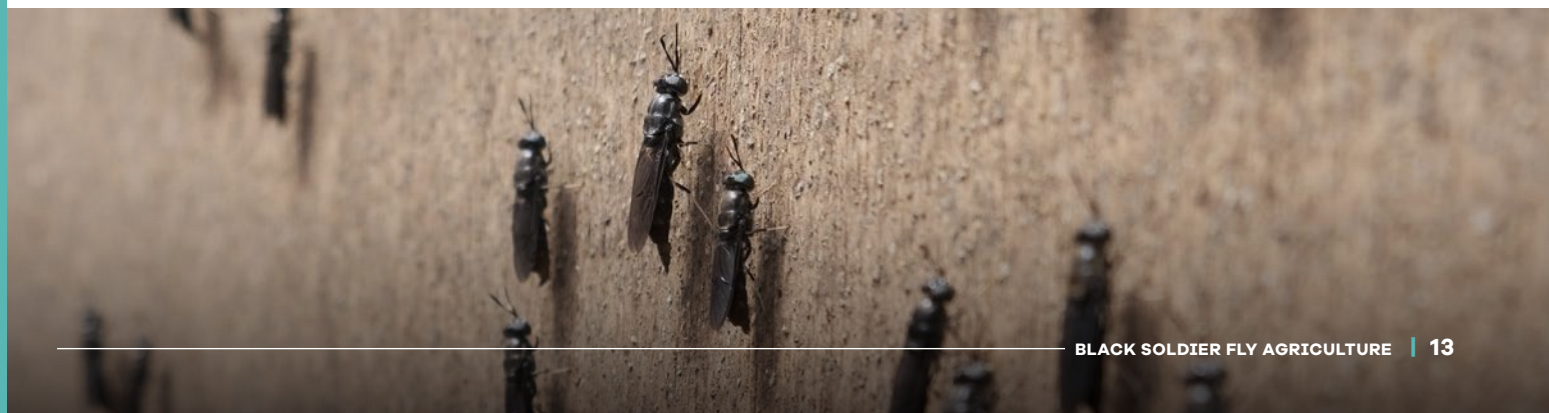


Figure 7: International fertilizer prices
Source: Quantec (2023)



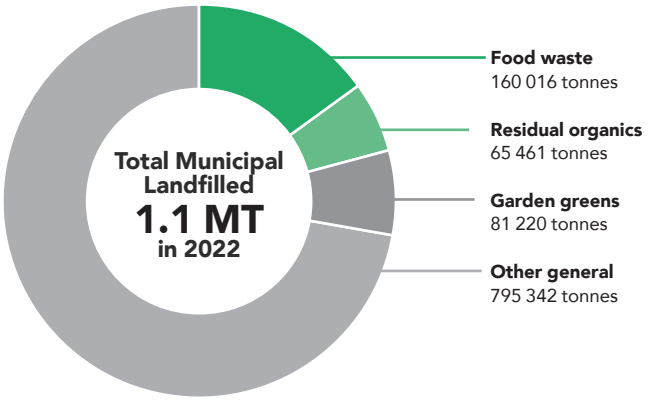


Figure 8: Organic waste landfilled in Cape Town in 2022
Source: Adapted from CCT (2023)

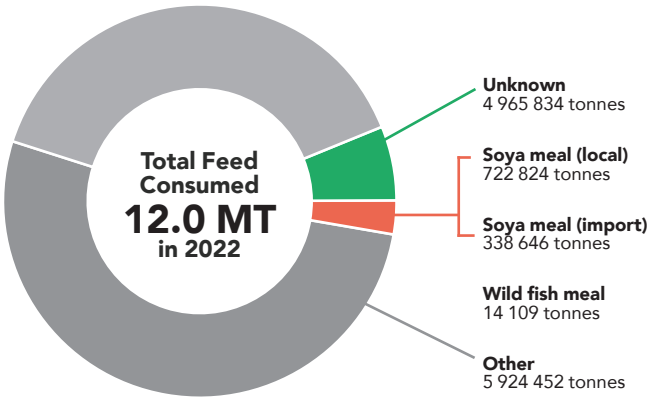


Figure 9: Total protein feed ingredients used in South Africa[22]
Source: AFMA (2023) and AFMA (2022/23)

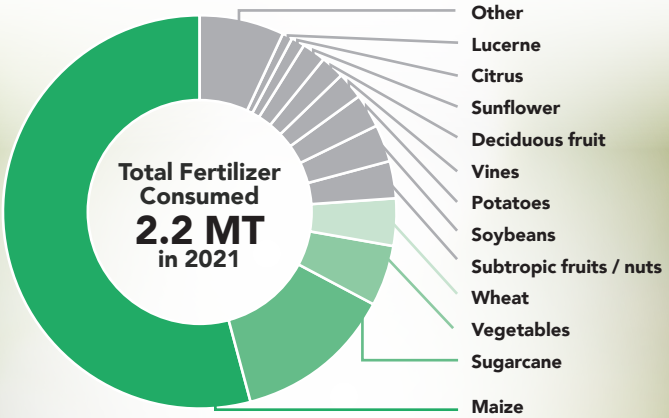


Figure 10: Total fertilizer consumer in SA by crop type for 2021
Source: Fertasa (2023)

Table 3: Summary of opportunities for Cape Town based BSF activities

OPPORTUNITY	TERM	DRIVERS	ENABLERS	RISKS & BARRIERS		WORTH NOTING
Organic waste treatment: Use BSF larvae as a waste treatment solution to reduce businesses disposal overheads and to ensure meet provincial disposal requirements are met.	Short	• Rising costs (above inflation) of managing waste. • Limited long term landfill lifespan / airspace. • Climate mitigation requirement. • Demand for waste jobs. • Growing demand for BSF products.	• Provincial organic waste landfill ban (2027). • National landfill diversion targets. • Progressive treatment norms and standards. • Increased green / carbon financing appetite. • Private sector landfill diversion commitments.	• Low cost of landfilling (until 2027). • Low separation at source rates. • Sensitive / strict off-take markets. • Competition with illegal pig feed. • Limit understanding by waste experts.	• Electricity security & costly backup. • Difficult to scale to meet mass demand. • Lack of mass insect rearing skills. • High capex requirements. • High lending rates & dependency on Venture Capital funding and equity loss.	• Wide spectrum of waste streams. • Faster turnaround than composting or biogas. • Can integrate composting and biogas. • Lower global warming potential than composting. • Less land needed to treat than composting and biogas. • On site or within urban and indoors.
Livestock feed ingredients: use the protein and lipid profile of BSF larvae to reduce the dependency on riskier and destructive ingredient sources for the preparation of livestock feed. The opportunity could be fast tracked if feed inclusion is partial to leverage the functional benefits.	Med - Long	• Rising demand for animal based products. • Rising cost of traditional food ingredients. • Price volatility of tradition food ingredients. • Demand for less risky protein and oil sources. • Demand for sustainable supply chains.	• Draft Feeds and Pet Food Bill. • Strong animal feed industry representative. • Effective export support via WESGRO. • Demand from progressive economies. • Low labour costs than developed economies.	• Lengthy (over a year) feed registration process. • Non-standardised BSF industry standards. • Limited access to clean traceable substrates. • Atmospheric emissions licence if drying larvae. • More expensive than traditional ingredients.		• The functional properties of BSF ingredients offset costs. • Using local organic waste instead ensures a stable price. • Hyper localised feed ingredient production. • Short protein turnaround (10-52days). • Insects are included in the EU Farm to Fork strategy.
Pet food ingredients: use the protein and oil profile, as well as the functional benefits of BSF to produce healthier, less destructive ingredient sources as for the preparation of pet food.	Short - Med	• Increasing demand for pets. • Rising cost of traditional food ingredients. • Demand for sustainable supply chains. • Demand for healthy functional food. • Growing acceptance of premium food.	• Draft Feeds and Pet Food Bill. • Strong pet food industry representative. • Demand from progressive economies. • Low labour costs than developed economies. • Major global brands acceptance.	• Lengthy (over a year) feed registration. • Non-standardised BSF standards. • Limited access to clean traceable substrates. • Atmospheric emissions licence if drying larvae.		• The functional benefits associated with insect ingredients ensures pet food is where, this is largely because pet owners are more likely to feed quality food to ensure healthy pets and are more conscious about their household sustainability. • BSF based protein ensures palatability of pet food.
Soil amendment: use nutrient profile and soil amendment characteristics of BSF larvae frass / excrement to supply farmers and limit dependency on riskier and costly synthetic fertilizer imports.	Short - Med	• Price volatility of synthetic fertilizers. • Demand for regenerative agriculture. • Demand for water smart agriculture. • Consumer demand for organic food products. • Supply chain availability.	• Increased green / carbon financing appetite. • Draft Fertilizer Bill. • Diverse numbers of composters to collaborate. • Carbon credit potential for offtake farmers. • Growing demand for regenerative agriculture.	• Lengthy (over a year) fertilizer registration. • Onerous registration of special label claims. • Information asymmetry of frass benefits. • Carbon credit accreditation is costly & onerous.		• BSF experts believe frass is a future premium product. • Water holding capacity ensures drought mitigation. • Frass can be integrated in composting and biogas. • Certain frass can be fed to livestock, including ruminants.

6 Current regulatory landscape

Historically, waste and agricultural regulations have not reflected the role insects play in natural food chains as converters of organic waste to feed and soil enhancers. As legislation plays a key role in shaping the commercialisation of food production, it is vital that regulations are updated to protect humans and animals, whilst not restricting the growth of South Africa's insect sector. Below are a number of regulations existing and future investors should consider.

6.1. Waste treatment regulations

The management of waste in South Africa is regulated by the National Environmental Management Waste Act (Act 59 of 2008).

The Act provides a list (GN921 of 2013) of waste management activities that require a an activity to secure a waste management licence, and undertake an environmental impact assessments (EIA). To reduce the regulatory burden, some activities have been downgraded to norms and standards.

Annexure 3 of the norms and standards for the treatment of organic waste (GN1984 of 2022) sets requirements for organic waste treatment facilities, including BSF.

Companies looking to integrate composting activities must adhere to the requirement of the norms and stranding for organic waste composting (GN561of 2021).

Companies looking to pre-process general organic waste must consider the norms and standards for the sorting, shredding, grinding, crushing, screening, chipping or baling of general waste (GN561 of 2021).

The CCT has a waste bylaw[24] that requires businesses sorting or recycling waste must be accredited with the City's Urban Waste Management department[25].

6.2. Animal feed regulations

South Africa's animal feed and pet food is regulated by the Fertilizers, Farm Feeds, Agricultural Remedies and Stock Remedies Act (Act 36 of 1947). The act does not limit the use of insect ingredients, but rather on health and safety parameters.

The feed industry seeks to unbundle the Act, and is currently developing a Feed and Pet Food bill[26] to addresses food safety, the environment, and regulatory burden. Veterinary Procure Notices (VPN)[27] set requirements for certain activities: VPN 41 covers farm feed mixing establishments for export, and VPN 43 covers pet food sterilizing establishment for export.

The standard operating procedure for approval of feed mills for EU export is a key consideration for registration of feed mills to be approved as a source of feed to farms approved for the export of meat to the EU.

6.3. Fertilizer regulations

Fertilizers, composts and soil conditioners are highly regulated by the Fertilizers, Farm Feeds, Agricultural Remedies and Stock Remedies Act (Act 36 of 1947), but more specifically, the Regulations Relating to Fertilizers (GN972 of 2017).

The industry is also seeking to unbundle the Act and finalising a fertilizer bill28.

6.4. Insect drying regulations

Facilities seeking to process - render, cook, dry, dehydrate, digest, evaporate, or concentrate protein – more than one tonne a day of animal matter not intended for human consumption, triggers Category 10 of listed activities in terms of Section 21 of the NEMAQA (Act 39 of 2004). This requires activities apply for an atmospheric emissions license through the City's Air Quality Management Unit.

7 Recommendations

To facilitate the scaling up of South Africa's BSF sector, a number of key recommendations have been identified for respective stakeholders, including:

Government / Agencies

- DALRRD to amend / introduce regulations addressing the inclusion of insect nuance into animal feed.
- DALRRD outline a BSF VPN as a guide for exporters of BSF products.
- DALRRD direct additional resources to accelerate animal feed registration application turnaround time[29].
- DALRRD direct additional resources to accelerate fertilizer registration application turnaround time.
- DALRRD and DSI curate funding mechanisms to support research into insect related agriculture.
- DTIC, DEADAT, WESGRO to develop a BSF specific promotion agenda for local and export markets.
- DEADP to consider exempting BSF facilities drying larvae from the need for an AEL for triggering category 10 of NEMAQA listed activities.

Insect industry

- Develop industry standards for feedstocks / substrates[30] to be considered for industry guidance.
- Provide input into the fertilizer bill, and the feed and pet food bill.
- Develop a roadmap to scale up insect protein production in the South Africa.
- Investigate Solar PV and battery storage to future proof energy security against load shedding.
- Develop a motivation for exemption for the need for a AEL for drying larvae.

Retailers / Brand owners:

- Partner with BSF farmers as off-takers of onsite organic waste, or engage with waste management companies to integrate BSF into their service offering.
- Promote the integration of BSF into products and supply chains.
- Lobby industry associations and regulators to include insect nuance feed and fertilizer regulations .

Financiers

- Financiers should familiarise themselves with the BSF technologies and business case.
- Green / carbon financiers should familiarise themselves with the potential impact of BSF industry on sustainability metrics.
- Investigate the integration of BSF into their portfolios.

Academia / Researchers

- Develop projects that are relevant to specifically mass insect rearing.
- Develop a research agenda focused on insect based products.
- Develop a research agenda focused on insect rearing efficiencies.
- Research the risks of using certain substrates as feed in insect production for animal feed.
- Direct research outcomes to SAMIRO to include on their website and to distribute to their members.
- Partner with BSF farmers to develop life cycle assessment projects for BSF farmers to justify green finance.

8 Annexure 1: Key contacts

BSF FARMERS AND BRIEF	INPUT CAPACITY AND STAFF SIZE	EXPORT	BUSINESS GROWTH	INPUT CAPACITY
AgriSect: Cape Town based start-up scaling its prototype to a small-scale facility. Major focus on BSF as a waste treatment solution to both pre-consumer and post-consumer food waste.	TBD <5	NO	Startup	
Amesect: Amesect is a Cape Town based BSF specific technology provider startup. A major focus on automated mobile systems inclusive of all stages of production.	NA <5	NO	Startup	
BSF Breeding: BSF Breeding is a Cape Town based supplier of live BSF neonates at scale to BSF rearing operations, and companies with high-volumes of organic waste to clear. BSF Breeding also consults on the building of BSF rearing facilities, including containerised rearing operations.	NA 5-25	YES	Startup	bsfbreeding.com
GenBioSol: GenBioSol is a Cape Town based BSF export providing a wide range of expertise to BSF production both locally and globally. Of particular note is GenBioSol provides organisation with an assessment for BSF integration into their operations, whilst also providing the BSF industry with technical expertise.	TBD <5	NO	Startup	genbiosol.com
Inseco: One of South Africa's largest BSF operation, with an input capacity of ±40 tonnes a day. The facility covers the full spectrum of BSF rearing and processing. Inseco processes a wide range of pre-consumer non-meat organics. Inseco has integrated an industrial scale de-packaging plant allowing Inseco to process packaged organics.	40/td >50	YES	Startup	inseco.co.za
Maltento: One of South Africa's largest BSF operations in South Africa, with an input capacity of ±20 tonnes a day (have secured funding to double production). Maltento focuses less on the protein profile of BSF, and more on the functional properties. The facility covers full spectrum of BSF rearing and processing. Maltento is very specific in feed substrate: spent grain from a local craft brewery, and fruit and vegetable pulp from a local agro-processors. Maltento is the first BSF company in the world to commercialise an insect-based palatant to enhance dry pet food flavours.	20/td >50	YES	Startup	maltento.com
Nutrient Loop: Nutrient Loop, also trading as Proticycle, is one of the largest BSF operations in South Africa, with an input ±10 tonnes a day The facility covers the full spectrum of BSF rearing and processing. Nutrient Loop process a wide range of pre-consumer non-meat organics.	10/td 5-25	YES	Startup	nutrientloop.com
Nutrisek: A Cape Town based technology provider of 25t/d waste-to-insect bioreactors. They build, own and operate integrated waste bioconversion facilities worldwide. Providing food waste producers and handlers with a turnkey BSF solution.	NA 5-25	YES (tech)	Startup	nutrisek.com

BSF ASSOCIATIONS	
Southern African Mass Insect Rearing Organisation (SAMIRO)	samiro.co.za
International Platform of Insects for Food and Feed (IPIFF)	ipiff.org
North American Coalition for Insect Agriculture (NACIA)	nacia.org
Asian Food and Feed Insect Association (AFFIA)	affia.org
Insect Protein Association of Australia (IPAA)	insectproteinassoc.com
Centre for Environmental Sustainability through Insect Farming (CEIFF)	insectcenter.org

OTHER INDUSTRY	
Animal Feed Manufacturers Association of South Africa (AFMA)	afma.co.za
Fertilizer Association of Southern Africa (FERTASA)	fertasa.co.za
Pet Food Industry Association of Southern Africa (PFISA)	pfisa.co.za
Organic Recycling Association of South Africa (ORASA)	orasa.org.za
List of Other Agricultural Commodity Associations	greenagri.org.za
South African Food Loss and Waste Voluntary Agreement	cgcsa.co.za

GOVERNMENT / AGENCY	
National Department of Forestry Fisheries and the Environment's (DFFE)	dffe.gov.za
Western Cape provincial Department of Environmental Affairs and Development Planning (DEADP)	westerncape.gov.za
City of Cape Town's Urban Waste Management Directorate (CCT:UWM)	capetown.gov.za
National Department of Agriculture, Land Reform and Rural Development (DALRRD)	dalrrd.gov.za
Western Cape provincial Western Cape Department of Agriculture (DoA)	westerncape.gov.za/dept/agriculture
Western Cape provincial Department of Economic Development and Tourism (DEDAT)	westerncape.gov.za/dept/edat
CCT's Air Quality Management Unit (CCT:AQM)	capetown.gov.za
WESGRO	wesgro.co.za

References

1. WEF (2023) - www.weforum.org/reports/global-risks-report-2023
2. Ritchi, H., Rosado, P., and Roser, M. (2023) - https://ourworldindata.org/environmental-impacts-of-food
3. https://www.un.org/en/dayof8billion#:~:text=On%2015%20November%202022%2C%20the,nutrition%2C%20personal%20hygiene%20and%20medicine
4. Ritchie, H. (2022) - https://ourworldindata.org/wild-mammals-birds-biomass
5. United Nations (2019) - www.population.un.org/wpp
6. World Bank (2020) - https://blogs.worldbank.org/nasikiliza/lets-not-miss-chance-feed-700-million-plus-people-who-will-live-west-africa-2050
7. Euromonitor Internaitonal as cited in Bloomberg (2023) - www.bloomberg.com/news/articles/2019-12-04/china-spends-29-billion-on-pampering-pets-as-birthrate-slows
8. Monogastric animals are animals that have one stomach. This includes animals like pigs, birds, fish, dogs, cats. This is different to remnant animals, such as a cow or sheep, that have more than one stomach and that swallow food only to bring it back up again to continue chewing.
9. Makkar et al (2014) as cited in WWF (2021) - www.wwf.org.uk/sites/default/files/2021-06/The_future_of_feed_July_2021.pdf
10. A Polycrises is a cluster of related global risks with compounding effects, such that the overall impact exceeds the sum of each part.
11. The SAFLWVA core signatories commit to reducing at least half of their food waste from entering landfills.
12. Fertilizers, fuel, pesticides
13. USDA (2023) - https://apps.fas.usda.gov/psdonline/circulars/oilseeds.pdf
14. Though this comparison is based on UK based BSF sources, the relevant could also be applied to the South African context.
15. End Pet Homelessness (2020) - https://endpethomelessness.com/downloads/State-of-Pet-Homelessness-Index-SouthAfrica.pdf
16. Statista (2023) - www.statista.com/outlook/cmo/food/pet-food/worldwide
17. Euromonitor (2023) - www.euromonitor.com/world-market-for-pet-care/report
18. Palatability is measure of food acceptance or the measure of preference of one food over another.
19. Fertasa (2022) - www.fertasa.co.za/wp-content/uploads/2021/03/Fertilizer-Usage-2020-and-2021-RSA.pdf
20. Quantec (2023) - www.easydata.co.za/dataset/TRD01
21. Meticulous Research (2023) - www.meticulousresearch.com/product/black-soldier-fly-market-5074?utm_source=digitaljournal&utm_medium=Paid&utm_term=Product&utm_content=25-04-2023
22. The known feed is what is reported by AFMA members to AFMA, whilst the "unknown" refers to non-AFMA feed modelled by AFMA (2022).
23. In 2021 reported that AFMA members contributed to 58% of national production. This contribution was used to project for 2022 national in relation to AFMA know total feed.
24. https://openbylaws.org.za/za-cpt/act/by-law/2009/integrated-waste-management/eng
25. www.capetown.gov.za/City-Connect/Register/Business-and-trade/Register-as-an-accredited-waste-services-provider
26. AFMA (2023) - www.afma.co.za/feeds-pet-food-bill
27. A list of VPNs can be located on the website: www.old.dalrrd.gov.za/Branches/Agricultural-Production-Health-Food-Safety/Animal-Health/importexport/vpnson
28. South African Government (2018) - www.gov.za/sites/default/files/gcis_document/201810/draft-fertilizer-bill-2018.pdf
29. This is not a unique barrier to BSF products, but the industry as a whole.
30. WWF:UK (2021) have developed an 10 criteria assessment framework for feedstocks and substrates for black soldier fly. These criteria can be found at: www.wwf.org.uk/sites/default/files/2021-06/The_future_of_feed_July_2021.pdf

This industry brief was made possible thanks to the support of the City of Cape Town

CITY OF CAPE TOWN ISIXEKO SASEKAPA STAD KAAPSTAD | INVEST CAPE TOWN | RESILIENT CAPE TOWN

For more information and support contact:

GreenCape: info@greencape.co.za | (021) 811 0250

GreenCape
Supporting the business of green