



BLACK SOLDIER FLY AGRICULTURE

Upcycling South Africa's
Organic Waste into Local,
Climate Friendly and
Resilient Feed for Livestock,
Pets, and the Soil

INDUSTRY BRIEF





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CONTENTS

	1 INTRODUCTION	2
	2 BACKGROUND	4
	3 THE BLACK SOLDIER FLY	6
	4 CURRENT STATUS OF BSF FARMING IN SOUTH AFRICA	10
	5 THE OPPORTUNITIES	14
	6 CURRENT REGULATORY LANDSCAPE	26
	7 RECOMMENDATIONS	28
	8 ANNEXURE: KEY CONTACTS	30
	9 REFERENCES	32



1

INTRODUCTION

We have entered the decade of polycrisis¹, where climate instability, ecosystem pressures, and geopolitical tensions are expected to exacerbate South Africa's already fragile food and feed supply chain. Such crises provide for an ideal opportunity for innovation and future proofing. One way to resilience 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 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. They function as pollinators, predators and/or as prey 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 day technology, a number of South African innovators are leveraging the insatiable appetite of the BSF larvae to upcycle traditionally 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 us.





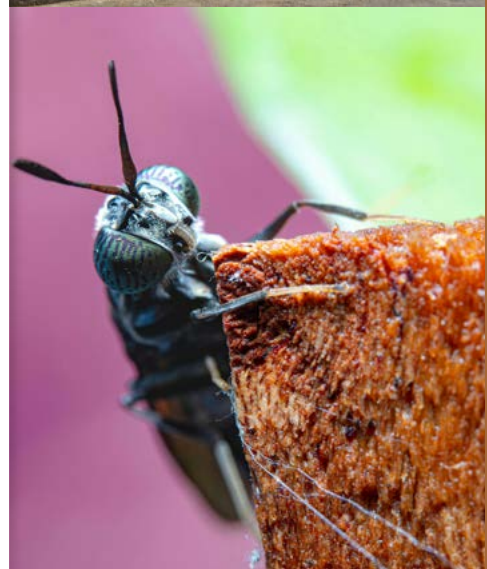
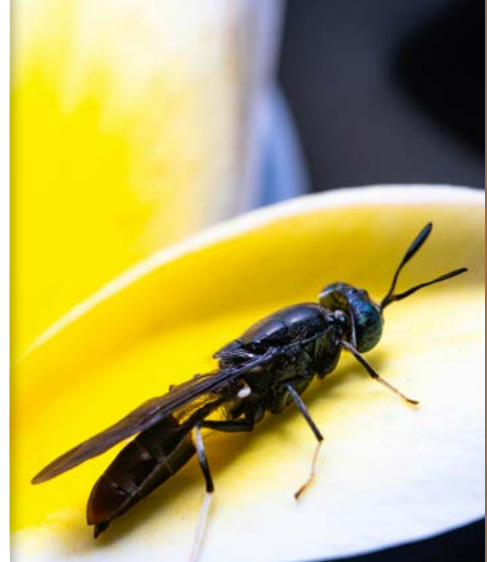
This industry brief covers the role BSF plays in fostering a more regenerative and competitive food system. The brief will also introduce the reader to the state of South Africa's BSF sector, illustrate the opportunities that exist for this sector, notably to keep organic waste out of landfills, futureproof animal feed supply, and futureproof healthy soils, all whilst creating jobs.

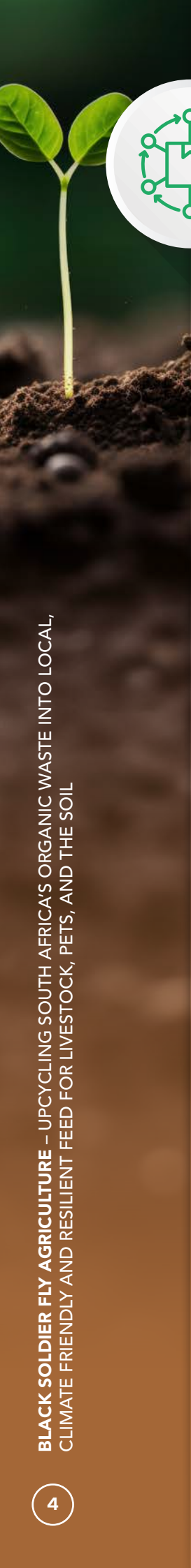
This industry brief is written for

- Financiers seeking investment opportunities
- Brands looking to future proof supply chains
- Regulators looking to support jobs and investment

The Industry brief discusses

- Role of BSF in future proofing South Africa
- State of South Africa's 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 production, whilst 17% takes place from distribution to consumer². South Africa fairs worse with ~45% of the ~22.8 million tonnes of edible food never eaten by people, with almost half (49%) of the loss and waste taking place during the processing and manufacturing stage³. This wastage is a symptom of what has become known as a linear economy.

Waste is only one symptom of the linear “take-make-waste” economy. Producing food requires a vast array of input resources, much of which are traded and transported on the global market. They require large swaths of land, much of which infringes on sensitive ecosystems; and is a major driver of climate change, both during production, in transport, and when landfilled.

The ecological, social, and economic shortfalls of such a system are well documented⁴, and exposes citizens, cities and nations, to chronic stresses and acute shocks. In general, these impacts are amplified when animals are included along the food chain. Much of this amplification can be attributed to growing/rearing the food that feeds the food that feeds humans.

This has all been to service the needs of a growing population, which reached over 8 billion in 2023. The human population is estimated to make up ~34% of all mammal biomass on Earth, whereas wild animals make up only ~4%, and livestock and pets make up the vast majority (~62%). As for birds, poultry makes up ~71% of global bird mass, whilst the remaining ~29% are wild⁵.





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 and 10.4 billion by 2100⁶, but also 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, but also companionship.

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 2050⁷.

The global growth in companionship animals such as cats and dogs is expected to rise⁸, notably in developing countries⁹.

Amidst these concerns, it is recognised that animals, and their associated services and products, will continue to play an integral part both globally and locally in South Africa's cuisine, cultural landscape, and livelihoods. Additionally, the demand for animal based products and service will remain strong as population and spending power increase.

It is thus important to ensure that the food value chain, including that of animals, are produced more sustainably, with circularity being a guiding principle.

Thus, the global food system is faced with three major incentives:

- ① Minimise the ecological footprint
- ② Maximising food security
- ③ Ensuring supply chain resilience

This is driving interest in more 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 not only activists, but also policy makers, investors, and brands, is insect based protein. Among the long list of candidate insects, the humble black soldier fly (BSF) is leading the swarm.





3 THE BLACK SOLDIER FLY

The BSF, *Hermetia illucens*, closely resembles a wasp rather than the common housefly. The BSF has a complex life cycle which includes five major stages over 39–47 days: egg, larval, pre-pupal, pupal, and finally adult fly. Although native to South America, BSF are widespread and virtually cosmopolitan, including in South Africa. It is worth noting that BSF is not regarded as an invasive species.

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 seek out food such as food crops or food waste that may cause contaminations. The purpose of the adult form is solely to locate mates and lay eggs.

It is only in larvae form do they seek out food. The larvae have also evolved to break down problematic bacteria and emit odours that repel traditional pests. Once the larvae have consumed enough nutrients, they pupate and prepare for metamorphosis into an adult fly.

Combining modern day innovation, BSF farmers from all over the world are able to leverage the insatiable appetite of BSF larvae to treat a wide range of organic waste streams, and subsequently process the pre-pupae and its excrement into a number of high value products discussed on the next page.

This farming can be undertaken at various scales from CAPEX intense industrial scale centralised facilities equipped with AI and automation, to cheap labour intense decentralised containerised operations.

Overall, BSFs are regarded not as pests, but as a sanitary solution to problematic 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	Intensive 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 (environmental footprint assessment)			
Land use footprint	Large area required	Small area used	Small area used
Carbon footprint	Direct	Cultivation and shipping	Fishing vessels
	Indirect	Land use change	Low indirect footprint
Water footprint	High water use	Limited evidence	Substrate dependent
			Low water use

Source: adapted from WWF (2022)



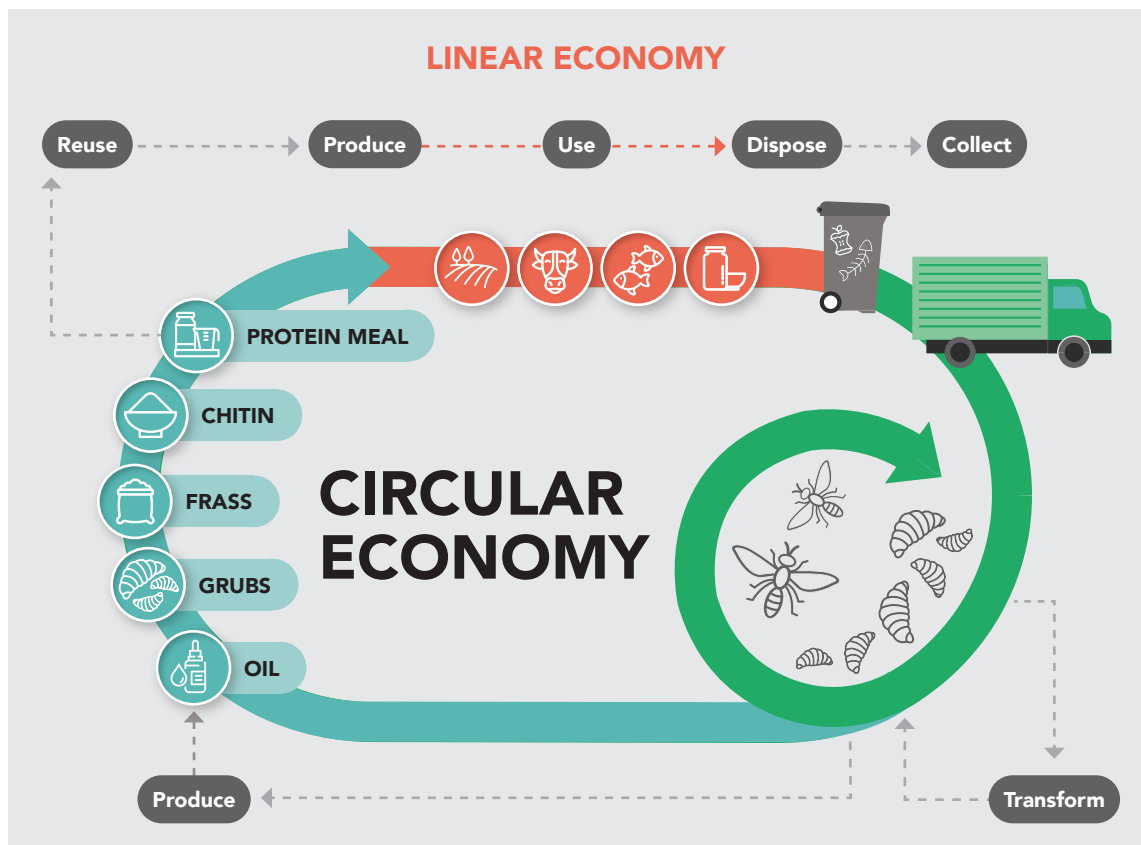


Figure 1: A schematic depicting a linear “produce - use - dispose” economy and a circular economy, incorporating BSF, which keeps products, components and materials at their highest use and/or value for as long as possible.

Grubs

Dried or frozen pre-pupae, that combine the benefits of protein, lipids, and chitin. Grubs can serve as an appropriate feed or feed ingredient for monogastric animals¹⁰.

Protein Meal

Defatted pre-pupae that is dried and milled into a balanced meal. The amino acid profile means that the meal can serve as a 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% protein¹¹, 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
- More sustainable than traditional protein sources (see [table 1](#))



Oil

High quality oil extracted and purified during the protein meal preparation. It 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 (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/bio-stimulant consisting of excreta, insect exoskeletons, and food residues. Serves as an alternative to fossil fuel based chemical fertilisers, but also has various benefits that foster healthy soils¹².

- Can be rich in 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 problematic pests
- High carbon content increases water holding capacity
- High carbon sequestration
- Slow release
- Co-applied with synthetic fertilizers

Niche

In addition to mainstay products, a number of BSF companies have developed, or are in the process of developing, niche products to differentiate themselves from competitors and competing commodities:

- Supplying eggs and neonates
- Producing flavour enhancers digests
- Curating probiotics for ruminants
- Microbial rich liquid plant stimulants
- Non-crustacean based chitin products¹³



4 CURRENT STATUS OF BSF FARMING IN SOUTH AFRICA

South Africa has a budding BSF industry, with a number of global leaders. Cape Town is regarded as the epicentre of South Africa's BSF industry, and a global hub for innovation.

In 2015, Cape Town made global headlines when Agriprotein established the world's first industrial scale insect rearing and processing facility. Since AgriProtein's closure in 2021, a number of companies continued to operate, grow and thrive, and new companies have, or in the process establishing in South Africa.

Figure 2 provides a map of companies with BSF activities. **Annexure 1** provides a short introduction to each BSF company. **Figure 3** summarises the processing capacity (not actual) of these companies in the short, medium and long term. **Figure 4** provides a summary of the potential meal, oil and frass that could be produced over the same period, based on the processing capacity.

Whilst the sector is growing in South Africa, the growth of the industry is lagging behind more developed economies, notably in Europe. In these other 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 illustrates a list of insect based companies, most of which are BSF related and have raised over \$1 million to date. In total, 37 companies from across the globe have collectively raised over \$1.79 billion. This includes the \$5.3 million raised by **Inseco**, and the \$4.1 million by **Maltento**, both of which are South African based.

It should also be noted that the European insect sector has attracted over €1,5 billion to date¹⁴.

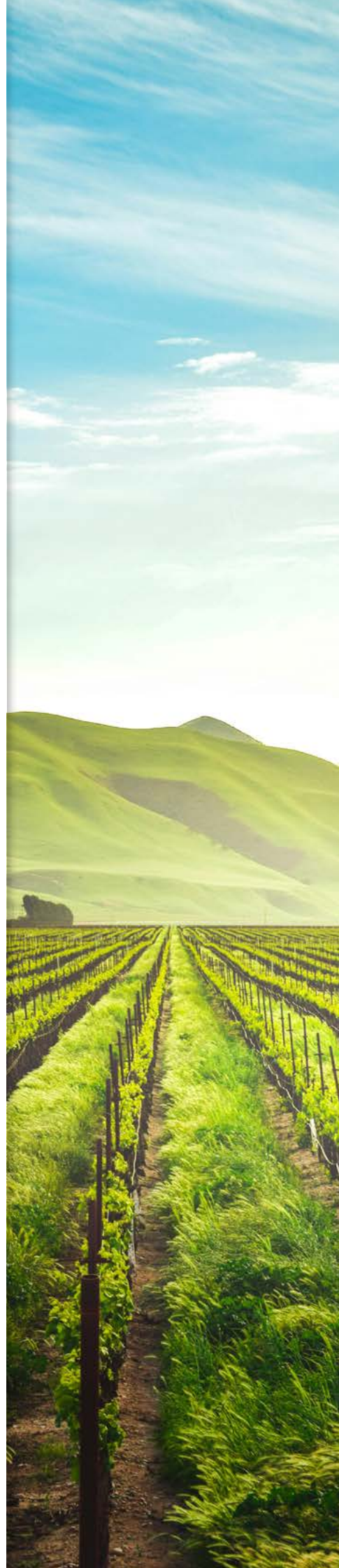




Table 2: Major investments in global insect companies

Company	Country	Funding Amount (US\$ mill)
Ynsect	France	\$579.10
InnovaFeed	France	\$479.48
Protix	Netherlands	\$227.10
Agronutris	France	\$57.87
Entosystem	Canada	\$52.43
Beta Hatch	United States	\$42.00
Nutrition Technologies	Singapore	\$34.00
Entobel	Singapore	\$33.25
BioFlyTech	Spain	\$24.10
Nasekomo	Bulgaria	\$23.83
FreezeM	Israel	\$23.60
Better Origin	United Kingdom	\$22.20
Aspire Food Group	United States	\$21.60
Future Fields	Canada	\$18.90
Invers	France	\$16.25
Entocycle	United Kingdom	\$16.00
Goterra	Australia	\$13.60
Grubbly Farms	United States	\$12,80
NextProtein	France	\$12.54
FarmInsect	Germany	\$11.35
Hargol FoodTech	United States	\$7.10
Tebritto	Sweden	\$5.43
FlyFarm	Hong Kong	\$5.40
Inseco	South Africa	\$5.30
Divaks	Lithuania	\$5.04
Bardee	Australia	\$5.00
Flybox	United Kingdom	\$4.60
Maltento	South Africa	\$4.10
Protenga	Singapore	\$4.00
HexaFLy	Ireland	\$4.00
Loopworm	India	\$3.40
Beta Bugs	United Kingdom	\$3.10
FlyFeed	Estonia	\$3.00
Entomo Farms	Canada	\$2.74
Petgood	Sweden	\$2.56
Chapul Farms	United States	\$2.50
Feedect	Spain	\$2.49
Inseact	Singapore	\$1.30
Insectta	Singapore	\$1.04
Total		\$1 794.30

Source: Industry Engagements and Crunchbase (2024)



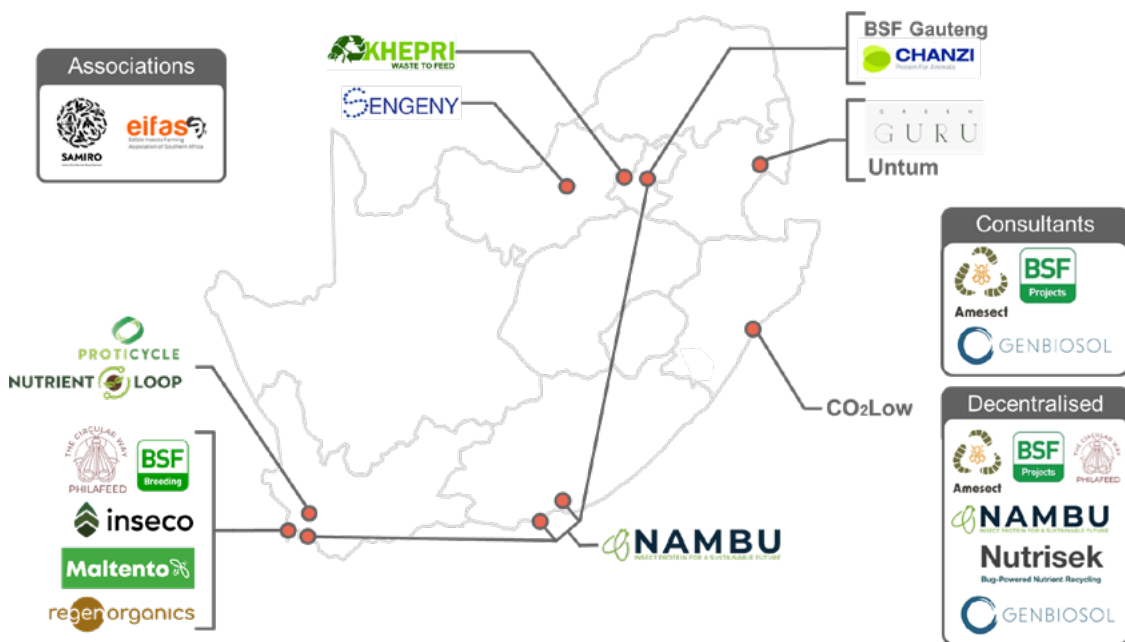


Figure 2: Stakeholder map of BSF related companies

Source: Industry Engagements

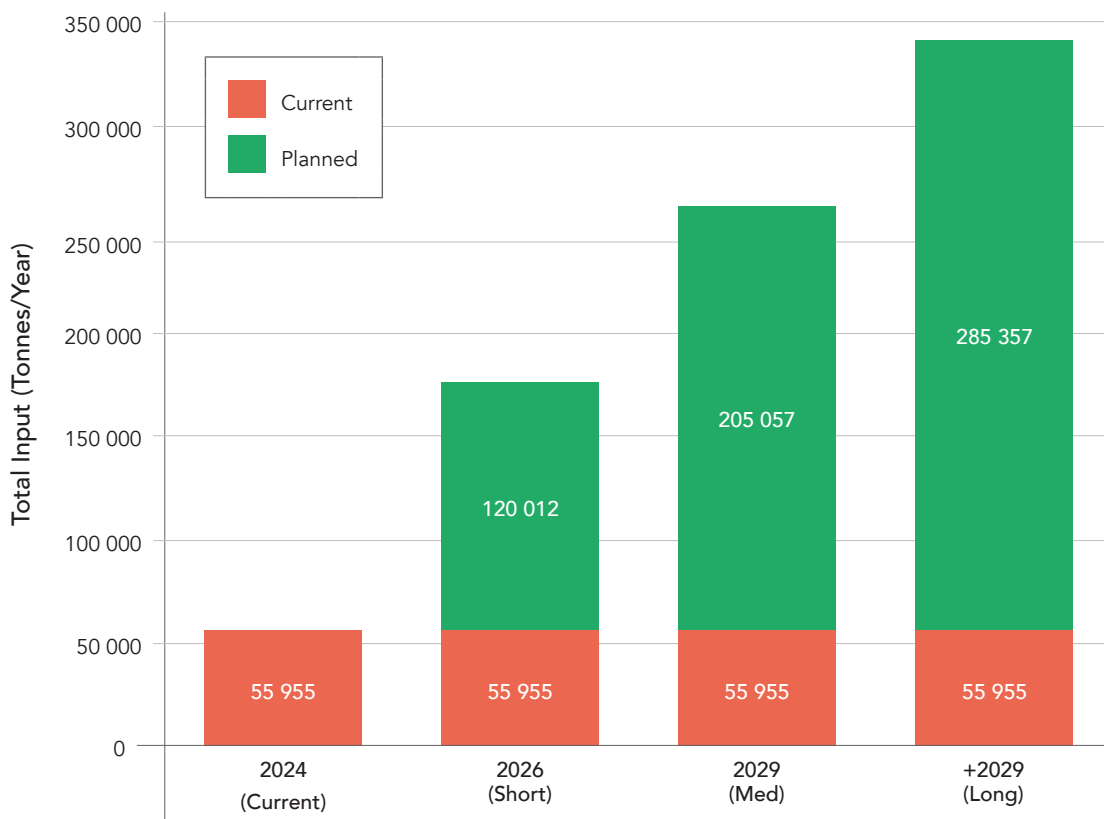


Figure 3: Summary of current and potential processing capacity of BSF companies in South Africa

Source: Industry engagements



Figure 4: Conservative product production projection based on current and planned input

Source: Industry engagements



5 THE OPPORTUNITY

The era of globalisation, as we knew it, is over, and a decade of polycrisis¹⁵ is upon us. Such a decade is expected to see a number of stresses and crisis, notably related to the environment and geopolitical strife. This should lead to supply constraints and price volatility for various goods and services, most notably food and animal feed, but also fertilizers.

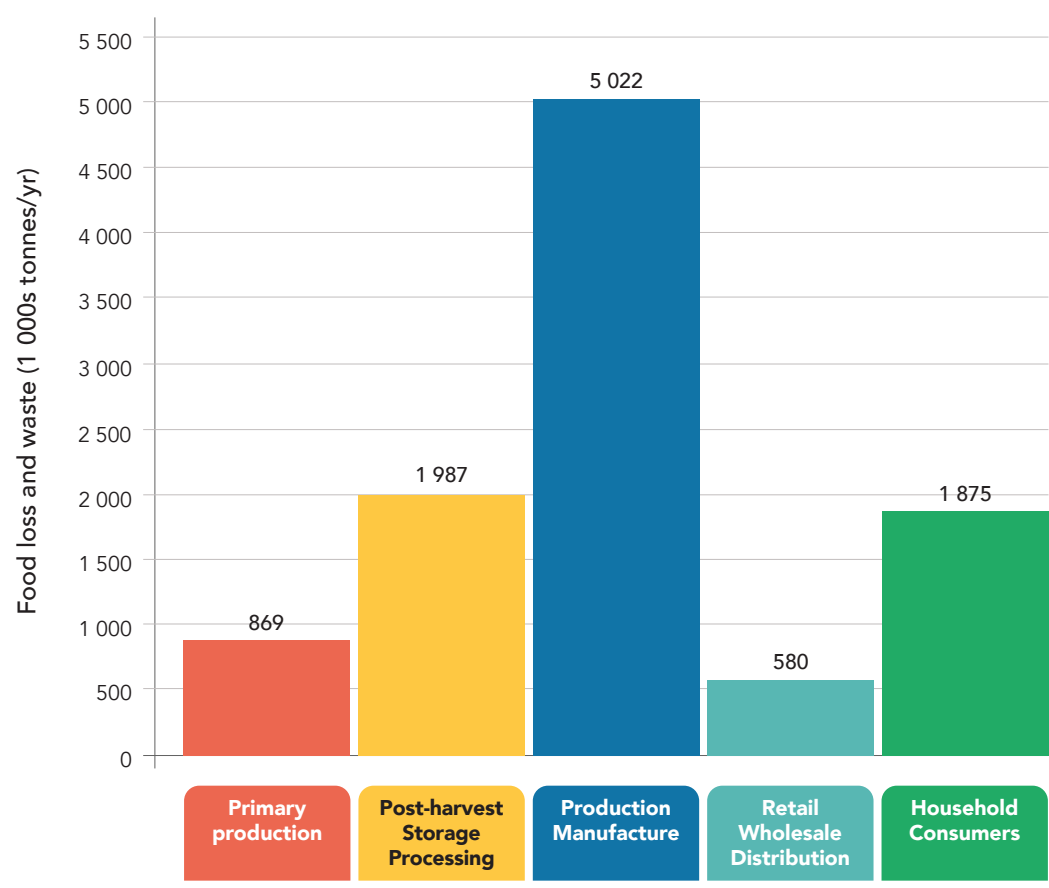
Such unstable conditions provide an ideal opportunity for innovation for future proofing. Future proofing is achievable through the circular economy principles, and nowhere is this better exemplified than through BSF.

At a global level, the BSF market is projected to grow 30.5% CAGR from 2022 to reach \$3.96 billion by 2033¹⁶. 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 the [annexure](#).

Figure 5 provides a summary of the potential value of to be unlocked through BSF treatment; whilst **table 4** summarises the opportunities for integrating BSF into a more circular food system. The opportunities will be discussed further.





Potential value extraction (Rands Billions)	Primary production	Post-harvest Storage Processing	Production Manufacture	Retail Wholesale Distribution	Household Consumers
	R1.8–R8.8	R4.0–R20.2	R10.2–R51.1	R1.2–R5.9	R3.8–R19.1

Loss/waste by commodity (1000's tonnes)					
Cereals	103	589	3 494	122	864
Fruit & vegetables	336	621	381	132	463
Milk	27	323	783	54	215
Meat	216	175	0	223	296
Roots & tubers	182	160	133	31	20
Oilseed & pulses	3	116	111	1	12
Fish & seafood	3	2	120	17	5

General feedstock considerations					
Location	Rural	Urban/peri-urban	Urban	Urban	Urban
Number of sources	Very few	Very few	Few	Dependant	Many
Feedstock type	Agricultural	Agricultural/Industrial	Industrial/Commercial	Commercial	Hospitality/household
Contamination levels	Low	Low	Low-Med	Med-High	High
Quality control	High	High	High	Med	Low
Feedstock supply	Seasonal	Seasonal	Consistent	Consistent	Consistent
Homogeneity	High	High	High	Med	Low
Disposal burden	Low	Med	High	High	Med-Low
Contract type	SLA	SLA	SLA	SLA	Tender

Figure 5: A summary of the BSF opportunity across the average food loss and waste chain in South Africa (2014–2018)

Source: Adapted from CSIR (2021)¹⁷, and industry engagements and value estimates from 2022

Table 4: Summary of opportunities for Cape Town based BSF activities

Opportunity	Term	Drivers	Enablers
<p>Organic Waste Treatment: use BSF larvae as a waste treatment solution to reduce businesses disposal overheads and to ensure national, provincial and local disposal requirements are met.</p>	Short	<ul style="list-style-type: none"> Rising costs (above inflation) of managing waste Limited long term landfill lifespan/airspace Climate mitigation requirements Demand for waste jobs Growing demand for BSF products 	<ul style="list-style-type: none"> 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
<p>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 BSF products are included as a partial inclusion into feed to leverage the functional benefits.</p>	Medium–Long	<ul style="list-style-type: none"> Rising demand for animal based products Rising cost of traditional food ingredients Price volatility of traditional food ingredients Demand for less risky protein and oil sources Demand for sustainable supply chains 	<ul style="list-style-type: none"> 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
<p>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.</p>	Short–Medium–	<ul style="list-style-type: none"> 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 	<ul style="list-style-type: none"> 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
<p>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</p>	Short–Medium–	<ul style="list-style-type: none"> Price volatility of synthetic fertilizers Demand for regenerative agriculture Demand for water smart agriculture Consumer demand for organic food products Supply chain availability 	<ul style="list-style-type: none"> 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



Risks and Barriers	Worth Noting
<ul style="list-style-type: none"> • 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 	<ul style="list-style-type: none"> • 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
<ul style="list-style-type: none"> • 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 	<ul style="list-style-type: none"> • 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 (10–52 days) • Insects are included in the EU Farm to Fork strategy
<ul style="list-style-type: none"> • Lengthy (over a year) feed registration • Non-standardised BSF standards • Limited access to clean traceable substrates • Atmospheric emissions licence if drying larvae 	<ul style="list-style-type: none"> • 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
<ul style="list-style-type: none"> • Lengthy (over a year) fertilizer registration • Onerous registration of special label claims • Information asymmetry of frass benefits • Carbon credit accreditation is costly and onerous 	<ul style="list-style-type: none"> • 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



Waste management opportunity

The use of BSF larvae as a treatment solution to organic waste is a short-to-medium term opportunity. This is especially the case for the Western Cape, and metropolitan municipalities.

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 largely reliant on the sale of high value products. This allows BSF solutions to strongly compete with other organics waste disposal solutions, ranging from landfill to composting and biogas. In some cases, organic waste is purchased.

It is estimated that ~10.3 million tonnes of food is lost or wasted along the food value chain. As illustrated by **figure 5**, almost two thirds of loss and waste takes place at points along the value chain largely associated with the urban landscape, including processing and manufacturing; retail, wholesale and distribution; household and consumption.

Almost half of the loss and waste takes place at the production stage: a stage associated with large volumes, homogenous, consistent, and clean waste streams. As such the waste management opportunity should be targeted at urban areas, notably metropolitan areas, of which South Africa has eight (**figure 10**).

This is for a number of reasons, most notably: the rising cost of landfilling, landfill restrictions for organic waste, and a number of private sector voluntary commitments.

These needs and drivers illustrates the short-to-medium term opportunity to provide businesses with a cheaper alternative to landfill disposal.

Rising cost of landfilling: The cost of landfilling increases year-on-year, and thus, so do overheads for companies that rely on landfilling. Some municipalities cost landfilling more realistically and exhibit greater than inflation increases. This further incentives companies to divert waste from landfill.

As illustrated by **figure 10**, the City of Cape Town has the highest municipal landfill gate fees, significantly higher than that of the other metropolitan areas of South Africa.

Organic waste landfill restrictions: The National Waste Management Strategy¹⁸, sets a number of strategic landfill diversion targets for municipalities. In order to meet these targets, organic waste has been identified as a major focus.



This should see provinces and municipalities implement landfill restrictions.

Already 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)¹⁹, whilst some companies have not committed to voluntary agreements, and have instead committed to their own internal targets. This information should be located in sustainability reports.



Livestock feed ingredient

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.

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 not only grow, but to thrive. Of particular importance are proteins, notably, 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 an adequate replacement to that of traditional sources such as, 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 11). 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 not only ensuring local food security, but also as an attractive export to premium paying markets. 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 (fertilizers, fuel, pesticides) needed to grow the local sources. This creates a supply risk during times of supply chain challenges, as have been experienced over the last several years.

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%)²⁰. This increases the vulnerability of production to the impacts of climate change and specific diseases.

Plant based 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 some plant 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 7 – figure 9).

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, BSF protein is considered more sustainable than soybean and wild fish caught sources²¹.

However, the price of BSF protein compared to soybean and wild caught fish sources is higher (figure 8). 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.



Pet Food Ingredient



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.

It is estimated that South Africa is home to a total of ~18.6 million cats and dogs in 2023. As illustrated by **figure 6**, a total of 11.7 million dogs and 3.5 million cats in homes and shelters require some form of pet food.

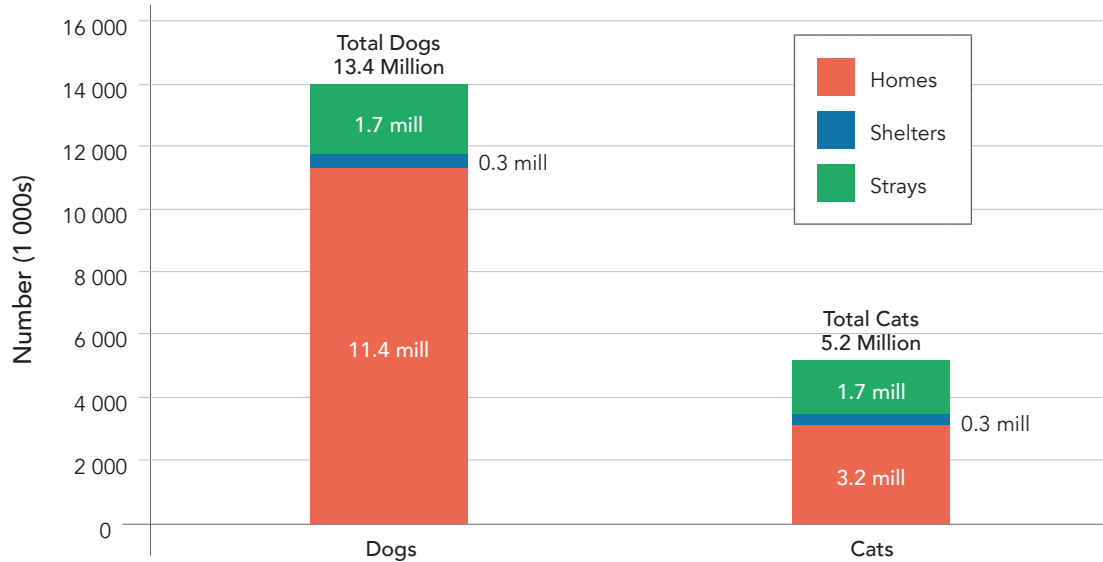


Figure 6: Total number of dogs and cats in South Africa (2023)

Source: State of pet homelessness project²²

In 2023 the global industry generated ~\$147 billion in revenue. This is expected to grow at a compound annual growth rate (CAGR) of 11% till 2027. 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 by 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 specifically.

Functionality: Pet owners, and by extension pet food manufacturers, want their pets to not only grow, but to thrive²⁴. To achieve this, pet food brands are relying on premium ingredients. This is a major driver 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 also shown to have a number of beneficial properties that facilitate healthy thriving animals: BSF meal is highly digestible, hypoallergenic, anti-inflammatory, and supports healthy gut microbiome.

Palatability: The flavour of food is a major consideration for pet food manufacturers. 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 rating to other protein sources, including plant based ingredients.

Lower Impact: Pet food manufacturers are under pressure from their customers and their shareholders to develop and produce sustainable products. However, where livestock feed is largely driven by the bottom-line, pet owners are more likely to pay a premium for food that is not only good for pets, but the planet too²⁴.

Demand for sustainable pet food is growing. Local manufacturers are already including insect based ingredients into their products, such as: [Nala](#), [Aiko](#), and notably [Bob Martin](#). The demand is also growing considerably in foreign markets too, notably Europe, but also North America, and Asia²⁵. This is not only niche brands, but Major brands like [Mars Petcare](#) and [Nestle Purina](#) have incorporated BSF into their products.



Soil security

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 fertilizers²⁶.

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 2022, South Africa consumed ~2.4 million tonnes of physical fertilizer products, of which ~0.7 million tonnes was NPK²⁷. **Figure 12**, shows ~76% of South Africa's fertilizer is used to grow just four commodities: maize, sugarcane, vegetables, and wheat.

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

Supply security: South Africa exported ~0.78 million tonnes of fertilizer in 2022, but imported ~2.2 million tonnes. This nett import of 1.45 million tonnes makes up 61% of the total 2.36 million tonnes consumed in 2022. 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, South African farmers ability to weather price volatility illustrated by **figure 9** are proving difficult. South Africa imported ~2.23 million tonnes of fertilizer in 2020 at a cost of R8.4 billion. By 2022, South Africa spent R24.8 billion on ~2.23 million tonnes²⁸. This translates to a tripling in price over just two years, and indicates price volatility along the food supply chain, including animal feed, and pet food.

Demand for organic: the demand for organic produce is on the rise, especially in South Africa's major export markets, such as the United States of America, and Europe. Local suppliers are under mounting pressure to develop more sustainable products and as such, are seeking organic inputs to replace synthetic fertilizers.

In Europe, a major trade partner of South Africa, this demand in sustainable and organic produce is largely driven through the Farm to Fork Strategy²⁹. This strategy is key to the European Green Deal, and aims to make food systems fair, healthy, and eco-friendly.

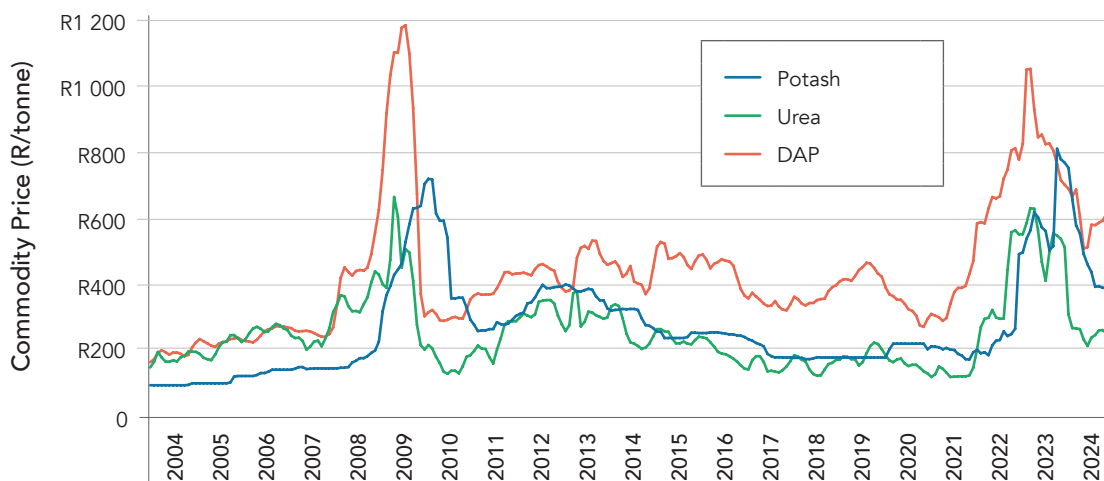


Figure 7: International fertilizer prices

Source: Quantec (2023)

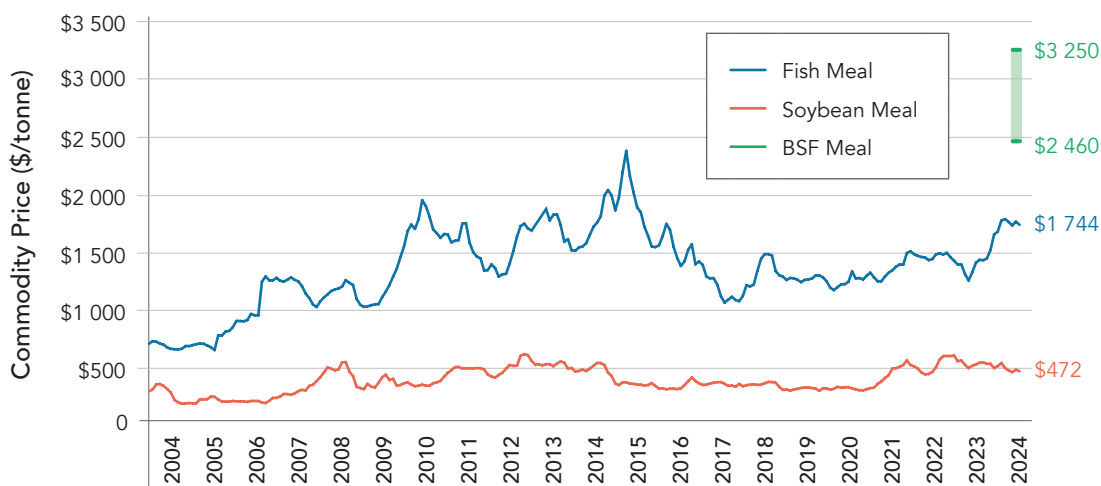


Figure 8: International fishmeal, soybean meal, and BSF meal (defatted) prices

Source: Quantec (2023)

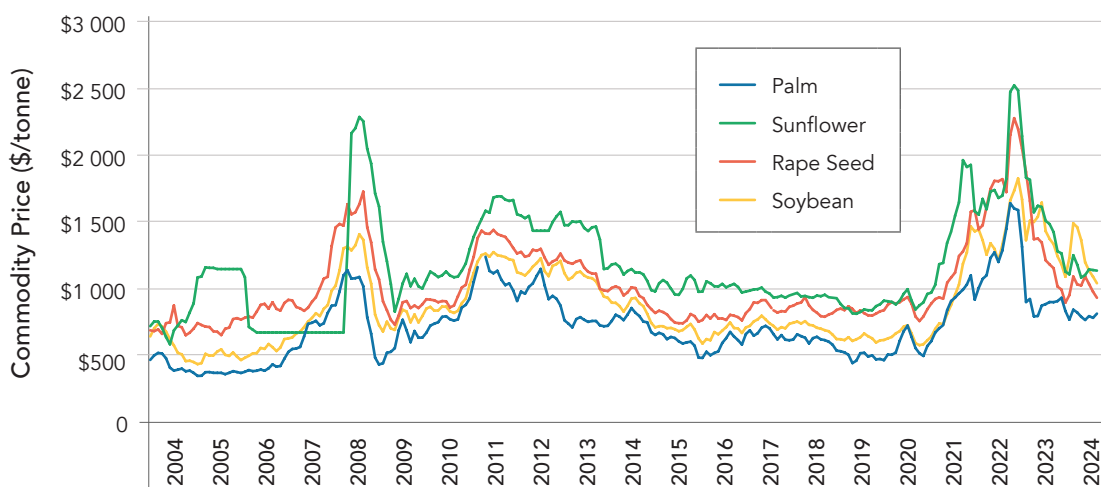


Figure 9: International vegetable oil prices

Source: Quantec (2023)

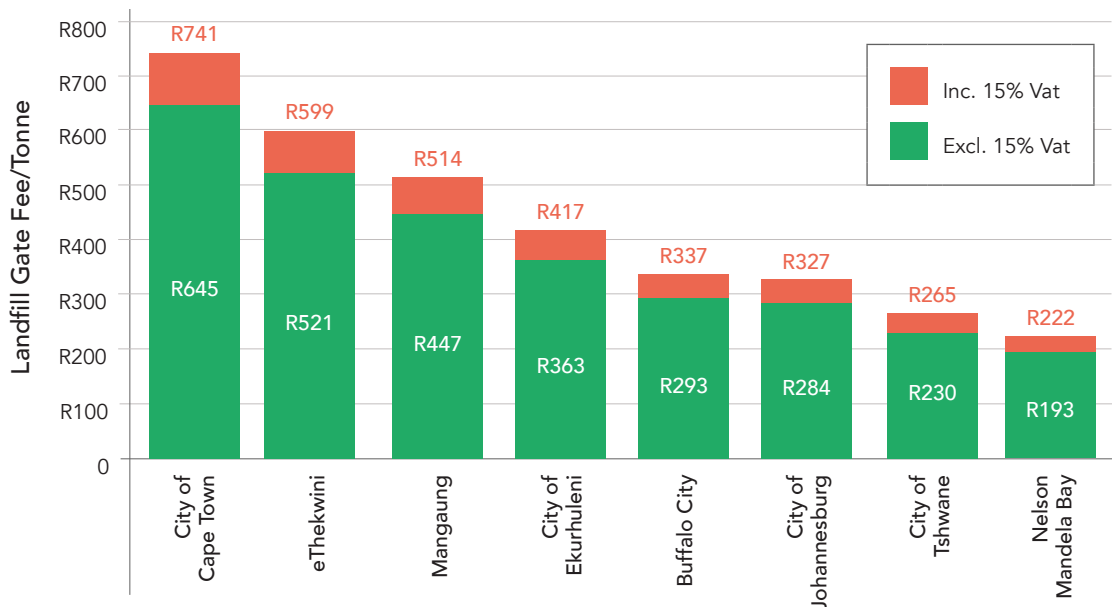


Figure 10: Municipal landfill gates fees for general waste (2024)

Source: Metro tariff books for 2023/24

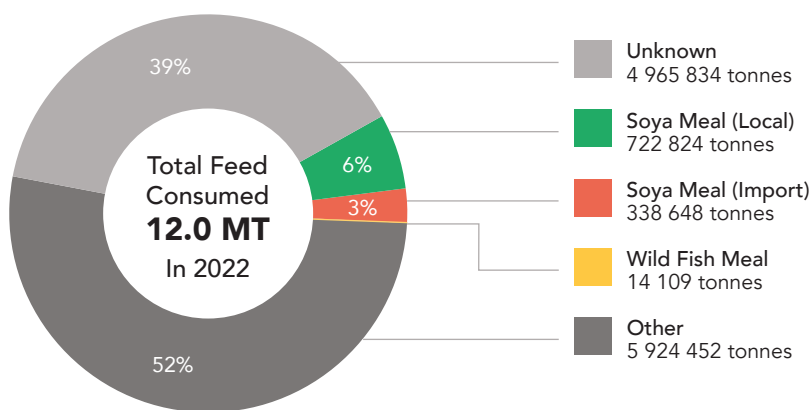


Figure 11: Total protein feed ingredients used in South Africa³⁰

Source: AFMA (2023) and AFMA (2022)³¹

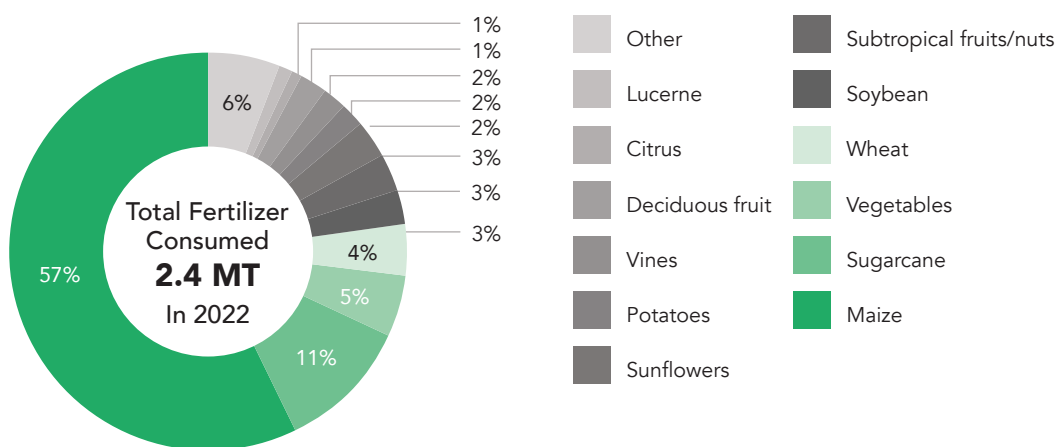


Figure 12: Total fertilizer consumer in SA by crop type

Source: Fertasa (2023)



6 CURRENT REGULATORY LANDSCAPE

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 regulations business/investors should consider.



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 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 (GN561 of 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).

Some municipalities may also regulate how waste is managed within their boundaries through waste specific bylaws³².



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.

Veterinary Procure Notices (VPN)³³ 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 the approval of feed mills for EU export is a key consideration for registering feed mills to supplying feed to farms that are approved for the meat export to the EU.



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](#))³⁴, but more specifically, the Regulations Relating to Fertilizers ([GN972 of 2017](#)).

Companies seeking to label/sell fertiliser must register each product. There are three groups to register fertilisers as:

Group 1: fertilisers containing a total of $\geq 100\text{g/kg}$ of NPK or any combination thereof.

Group 2: fertilisers containing a total of $< 100\text{g/kg}$ of NPK; or any combination thereof; or any other recognised plant nutrient(s) in acceptable amounts as indicated.

Group 3: a fertiliser containing natural or synthetic substance(s) or organisms(s) that improve(s) or maintain(s) the physical, chemical or biological condition of the soil.



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](#))³⁵. This requires activities to apply for atmospheric emissions licenses through the municipal air quality management departments.





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 time³⁶
- 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/substrates³⁷ to be considered for industry guidance
- Provide input into the draft fertilizer bill
- Provide input into 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: KEY CONTACTS

BSF Growers	Brief	Input Capacity	Staff Size	Product Export	Website
AgriSect	Very early stage 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	1-5	No	NA
BSF Breeding	Cape Town based supplier of cheap BSF neonates to BSF rearing operations, and companies with high-volumes of organic waste to treat. BSF Breeding also consults on the building of BSF rearing facilities, including containerised rearing operations.	NA	5-25	Yes	www.bsfbreeding.com
BSF Gauteng	A future Johannesburg based BSF grower and processor currently going through EIA process for a centralised facility with an input processing capacity of 100t/d, but will likely have a 45t/d input capacity in the short term.	TBD	TBD	TBD	TBD
Chanzi	A Tanzanian based low technology modular BSF grower and processor that are cheaper, and require lower skilled needs lower capital than larger centralised facilities. The intention is to establish a facility in Johannesburg.	TBD	TBD	TBD	www.chanzi.co
CO2Low	Early stage Durban based BSF start-up. Major focus on BSF as a waste treatment solution to both pre-consumer and post-consumer food waste.	<1t/d	1-5	No	NA
GreenGuru	A Mbombela based SMME waste managed company expanding its service offering to include a BSF treatment. The BSF start-up has a focus on treating both pre-consumer and post-consumer food waste from a number of existing clients.	<1t/d	1-5	No	www.greengurusolutions.co.za
Inseco	A centralised Cape Town based BSF grower and processor. The facility covers the full spectrum of BSF rearing and processing. Inseco processes a wide range of pre-consumer non-meat based organics. Inseco has integrated an industrial scale de-packaging plant allowing Inseco to process packaged organics.	40t/d	50-75	Yes	www.inseco.co.za
Khepri	A Johannesburg based BSF grower and processor with two sites outside of Johannesburg. They focus on-site processing of organic waste products from food manufacturers, abattoirs and the hospitality sector.	20t/d	5-25	NO	www.khepri.co.za
Maltento	A centralised Cape Town based BSF operation. 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 what its feed substrate and is highly committed to traceability. Maltento is the first BSF company in the world to commercialise an insect-based palatant digest to enhance animal feed flavours, notably pet food.	35t/d	50-75	Yes	www.maltento.com
Nambu	Develop and operate low technology, distributed BSF operations that are cheaper, and require lower skilled needs lower capital than larger centralised facilities. Nambu currently operates three sites, and has an aggressive rollout strategy throughout South Africa.	22 t/d	5-25	Minimal	www.nambugroup.com/



BSF Growers	Brief	Input Capacity	Staff Size	Product Export	Website
Philafeed	A BSF consultancy, BSF container technology supplier, and have recently moved operations to Cape Town, and are in the process of setting up their own BSF growing and processing facility.	TBD	TBD	TBD	www.philafeed.co.za
Proticycle	A centralised Worcester based BSF operations. The facility covers the full spectrum of BSF rearing and processing. Proticycle processes a wide range of pre-consumer non-meat organic into a premium quality golden roasted larvae using proprietary drying technology. Proticycle, also trades as Nutrient Loop for the USA market,	5t/d	5-25	Yes	www.proticycle.com
Regen Organics	A Kenyan based BSF company focused on processing a wide spectrum of input organics. Regen Organics has a South African footprint and has recently established small-scale trial operations in Cape Town, with a medium-term intention to formalise and grow operations in Cape Town.	TBD	TBD	TBD	www.regenorganics.co
Sengeny	Sengeny aims to address the cost pressures of commercial and subsistence farmers within South Africa in order to ensure economically sustainable practices take place. Sengeny leverage BSF frass as a unique product offering beyond purely soil amendment.	TBD	TBD	TBD	www.sengeny.co.za

BSF Support	Brief	Website
Amesect	A Stellenbosch based BSF consultancy with decades of experience; as well as a technology supplier of multi sized modular systems inclusive of all stages of production that allow for processing and price flexibility.	www.amesect.co.za
GenBioSol	A Cape Town based consultancy providing a wide range of BSF related expertise to organic waste producers, BSF producers. Strong focus on unconventional waste streams and innovative product development.	www.genbiosol.com
Nutrisek	A Cape Town based technology provider supplying 20t/d automated modular BSF bioreactors.	www.nutrisek.business.site

Global BSF Related Industry Bodies	Focus Region	Website
Southern African Mass Insect Rearing Organisation (SAMIRO)	South Africa	www.samiro.co.za
Edible Insect Farming Association of Southern Africa (EIFASA)	South Africa	www.eifasa.com
International Platform of Insects for Food and Feed (IPIFF)	Europe	www.ipiff.org
North American Coalition for Insect Agriculture (NACIA)	North America	www.nacia.org
Asian Food and Feed Insect Association (AFFIA)	Asia	www.affia.org
Insect Protein Association of Australia (IPAA)	Australia	www.insectproteinassoc.com
Insect Bioconversion Association (INBIA)	United Kingdom	www.inbia.net
Centre for Environmental Sustainability through Insect Farming (CEIFF)	International	www.insectcenter.org

Key Industry Bodies	Website
Animal Feed Manufacturers Association of South Africa (AFMA)	www.afma.co.za
Consumer Goods Council of South Africa (CGCSA)	www.cgcsa.co.za
Fertilizer Association of Southern Africa (FERTASA)	www.fertasa.co.za
Organic Recycling Association of South Africa (ORASA)	orasa.org.za
Pet Food Industry Association of Southern Africa (PFISA)	www.pfisa.co.za
South African Health Products Regulatory Authority (SAHPRA)	www.sahpra.org.za



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10. Monogastric animals are animals that have one stomach. This includes animals like pigs, birds, fish, dogs, cats. This is different to ruminant 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.
11. 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
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31. 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.
32. The City of Cape Town has established its own integrated waste management bylaw: <https://openbylaws.org.za/za-cpt/act/by-law/2009/integrated-waste-management/eng/>
33. 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
34. The fertilizer industry seeks to unbundle the Fertilizers, Farm Feeds, Agricultural Remedies and Stock Remedies Act (Act 36 of 1947) and have developed a fertilizer bill and subsequently to inform a separate act governing fertilizers. A copy of the bill can be found at www.gov.za/sites/default/files/gcis_document/201810/draft-fertilizer-bill-2018.pdf
35. At the time of publishing, the DFFE were in the process of reviewing the listed activities, and was preparing for public comment. This includes category 10.
36. This is not a unique barrier to BSF products, but the industry as a whole.
37. 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



BLACK SOLDIER FLY AGRICULTURE

Upcycling South Africa's
Organic Waste into Local,
Climate Friendly and Resilient Feed
for Livestock, Pets, and the Soil

INDUSTRY BRIEF

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