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Final Report:

Waste-based Insect Farming for Resource Efficiency and Climate Protection

Bioconvision (Switzerland) GmbH



Author(s):

Sheila Mbeguya von Hoerner, Bioconvision (Switzerland) GmbH
Konstantin von Hoerner, Bioconvision (Switzerland) GmbH

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Prepared by:

Bioconvision (Switzerland) GmbH
Steinentischstrasse 17
8002 Zürich, Switzerland
Tel: +41 (0) 789 15 24 88
info@bioconvision.com / www.bioconvision.com



With the Support of:

REPIC Platform
c/o NET Nowak Energy & Technology Ltd.
Waldweg 8, CH-1717 St. Ursen
Tel: +41(0)26 494 00 30, Fax: +41(0)26 494 00 34
info@repic.ch / www.repic.ch

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Summary

Why this project was implemented

Uganda faces acute challenges in waste management and feed security. Rapid urbanisation has outpaced organised waste collection and treatment, while livestock and fish producers struggle with high feed costs and a heavy reliance on imported soy and fishmeal. At the same time, youth unemployment and increasing climate vulnerability place additional pressure on local economies. These overlapping challenges created a clear need for locally grounded, circular solutions that address multiple constraints simultaneously. The project was therefore designed to demonstrate the commercial viability of insect farming as part of sustainable waste management and to establish a reliable local supply of high-value farm inputs.

What was implemented

The project developed and validated an integrated insect-based waste treatment model. It began with the establishment of a Black Soldier Fly reproduction unit in Wakitaka, Jinja, designed to produce young larvae consistently and cost-effectively. In parallel, technical design trials were conducted to identify efficient treatment configurations and to test machinery for shredding, mixing, and handling organic waste. The resulting system became the blueprint for the commercial waste treatment plant in Mafubira, designed to process up to 5'000 tons of organic waste per year and to produce market-ready insect-based feed and organic fertiliser.

How the project was carried out and what objectives were achieved

Implementation followed a structured learning-by-doing approach, combining Swiss technical expertise with Ugandan field experience. Instead of relying on a fixed blueprint, the system was refined iteratively under real operating conditions. Key achievements include:

- Establishment of a fully operational Black Soldier Fly reproduction unit delivering consistent, high-quality larvae.
- Validation of process efficiencies and design parameters, forming a robust blueprint for commercial replication.
- Successful transition from a one-ton pilot operation to a fully operational commercial-scale facility.
- Employment and training of local youth and women in waste handling and insect farming.
- Effective knowledge transfer through close collaboration with EAWAG and local partners.

Within less than two years, Bioconvision progressed from a research-oriented pilot to full market readiness. The project demonstrated that waste-based insect farming can evolve from applied research into a commercially viable, scalable, and climate-smart solution for Uganda's circular economy.

Further actions to be undertaken

Building on this validated foundation, Bioconvision will:

- Fully utilise and further develop the commercial treatment site in Mafubira.
- Improve product quality, consistency, and sales performance.
- Further assess and document the carbon-emission avoidance potential of the technology.
- Prepare the replication of the model in other Ugandan cities.

Starting Point

Initial Situation at Project Start



Wakitaka Site, in its original state as an abandoned maize mill, August 2023

At the beginning of the project, we effectively started from zero. Operations were initially based in an abandoned maize mill, with no functional equipment in place, no prior hands-on experience in insect farming, and no operational background in organic waste management. What we did have, however, was a clear strategic vision and a structured, step-by-step technical guideline developed by our research partner EAWAG. This framework provided the scientific foundation for establishing a Black Soldier Fly reproduction system. To translate this theoretical knowledge into practical operation, we engaged Tina Kusumawardhani, an experienced Black Soldier Fly specialist from Indonesia who had previously worked with EAWAG on the same reproduction model.

The first weeks and months were characterised by intensive practical experimentation. We tested substrates, breeding configurations, tools, and improvised equipment, often involving repeated and time-consuming sourcing trips through Kampala to identify components that were fit for purpose. From the outset, the project followed a clear guiding principle: to source materials, inputs, and equipment locally wherever possible, deliberately keeping imports to an absolute minimum. This approach was driven by cost considerations, supply-chain resilience, and the ambition to develop a model that could be replicated using locally available resources.

In parallel, the abandoned maize mill was fully refurbished. This work included cleaning accumulated maize dust, repairing the roof, pouring new concrete flooring, and extending the veranda to create additional functional space. Somewhat unexpectedly, the building itself proved to be a valuable asset. Its thick walls and limited window openings created a naturally stable environment with moderated light, humidity, and temperature conditions, which turned out to be highly suitable for critical stages of the Black Soldier Fly breeding process.

After a few months, the project reached a major breakthrough: the first cohort of young Black Soldier Fly larvae was successfully brought on site. This marked the point at which theory turned into practice. Step by step, an engineered biosystem was established that covered the full lifecycle of the insect, including mating cages, egg-laying structures, a hatchling “shower” in which freshly hatched larvae (neonates) fell directly into the feedstock, a prepupation area where larvae completed their feeding phase, pupation boxes, and finally dark cages where metamorphosis was completed and adult flies emerged.

At this stage, everything remained small-scale and inefficient, driven by constant trial and error. Setups were adjusted, rebuilt, and tested almost daily. Yet one observation became clear very quickly: the system worked. From the day the first adult flies emerged, insects were continuously present on site. The colony was never lost, and no step of the lifecycle failed completely, even when a severe tropical thunderstorm caused significant damage to the facility. This early resilience gave us confidence that, despite its rough beginnings, the biosystem was fundamentally sound and could be stabilised, scaled, and refined over time.

Objectives

Project's Original Objectives

The project was designed to develop, validate, and leverage a waste-based insect farming model in Jinja, Uganda, combining urban waste management with climate-smart animal feed production. Over a 21-month period, the objective was to establish a fully operational Black Soldier Fly farm that converts locally available organic waste into high-quality insect-based feed and organic fertiliser, while generating measurable environmental, social, and economic benefits. A central ambition was to demonstrate that insect farming can reduce dependency on imported fishmeal and soy, lower greenhouse gas emissions linked to landfill disposal and conventional feed production, and strengthen the resilience and autonomy of local farmers.

To achieve these objectives, the project was structured in three sequential phases. Phase I focused on building the technical foundation by establishing a functional reproduction unit, refurbishing and equipping the site, training the core team, and achieving the first successful reproduction cycles. This phase aimed to process initial quantities of organic waste and generate the first sales of insect-based feed and organic fertiliser, thereby demonstrating technical feasibility at pilot scale.

Phase II shifted the focus towards expansion and commercialisation. Key objectives during this phase included the construction of a dedicated treatment unit, a rapid increase in waste intake, the stabilisation of production volumes, and the initiation of structured market engagement for both feed and fertiliser products.

Phase III was designed to leverage additional waste streams and substrates, quantify the climate impact of the system through life cycle assessment and product carbon footprinting, and prepare replication through decentralised treatment units supplied by a central larvae production facility. While the original concept envisaged testing a franchise-style rollout within the project period, implementation prioritised partnership-based replication pilots, while retaining the franchise pathway as a longer-term mechanism once suitable operators are sufficiently prepared.

Beyond technical scale-up, the project placed strong emphasis on knowledge transfer, capacity building, and inclusion. In close collaboration with EAWAG and experienced Black Soldier Fly practitioners, the project aimed to co-develop adaptive blueprints, standard operating procedures, and training curricula that could be shared openly. Hands-on training at both the reproduction and treatment sites was intended to empower smallholder farmers and practitioners to adopt insect farming techniques, while digital tools and expert networks supported wider dissemination of knowledge.

A further core objective was to improve livelihoods, particularly for women and young people in the Jinja and Busoga region, through direct employment, skills development, and indirect job creation along the waste and feed value chain. All objectives were translated into clear milestones across the three phases, ranging from the first successful reproduction and waste treatment runs to large-scale daily waste processing, commercial sales, secured project financing, climate impact assessment, and preparation for replication. Together, these objectives defined a clear pathway from pilot experimentation to a scalable, climate-relevant, and socially inclusive production model.



Mafubira Site, pouring concrete foundations for the treatment houses, October 2024

Project Review

1. Project Implementation

The project was implemented in three phases, progressing from technical set-up and experimentation to commercial operation. Overall implementation followed the outline of the original project application. Across all phases, the approach combined hands-on, day-to-day implementation on the ground with close technical support from the research partner EAWAG. Rather than following a rigid blueprint, the project evolved as an adaptive process, allowing for learning, adjustment, and refinement under real operating conditions in Uganda.

Phase I – Building the foundation focused on establishing the core technical system of the insect farm. During this phase, Bioconvision refurbished the reproduction site, sourced and assembled equipment, recruited and trained the initial team, and implemented the Black Soldier Fly reproduction model developed together with EAWAG. Strong emphasis was placed on practical experimentation, local sourcing of materials, and the gradual stabilisation of each step of the insect lifecycle. The first successful reproduction cycles, the treatment of initial quantities of organic waste, and the first sales of insect-based feed and organic fertiliser marked the transition from theory to practice. This phase demonstrated that a complete Black Soldier Fly biosystem could be built and operated reliably using largely local resources.

Phase II – Expansion and stabilisation focused on scaling operations and moving towards commercial relevance. A dedicated treatment unit was developed, partnerships for sourcing organic waste were strengthened, and daily waste intake was gradually increased. As volumes grew, the production of larvae and fertiliser increased accordingly, and sales activities expanded. In parallel, operating routines were refined together with EAWAG, improving consistency, efficiency, and process control. By the end of this phase, larval reproduction was stable, daily waste treatment had reached multi-ton scale, and the project had demonstrated its ability to generate revenue while maintaining operational and environmental performance.

Phase III – Leveraging and replication focused on unlocking the wider potential of the platform. Access to additional waste streams and substrates was expanded, including agro-industrial by-products. Scientific assessment of environmental performance was initiated through life cycle assessment and product carbon footprinting, providing evidence for the climate benefits of the system.

Replication was originally planned to be tested through a franchise-style rollout within the project timeframe. While the franchise concept remains part of the longer-term strategy, it requires additional time to prepare potential operators and to build the confidence, operational discipline, and market maturity needed for successful decentralised waste treatment. In practice, replication efforts initially focused on partnership-based models with established waste generators, as this allowed faster learning under controlled conditions and reduced operational risk.

Across all three phases, the project's core objectives remained unchanged. The ambition to develop a scalable, waste-based insect farming model with positive climate, social, and economic impact remained fully intact. However, the implementation pathway was refined as experience accumulated. Timelines for certain infrastructure elements and scale-up steps were adjusted to reflect permitting processes, site development realities, and the biological need to stabilise systems before further expansion. These adjustments did not dilute the project's objectives; instead, they strengthened the overall outcome by ensuring that growth was robust, resilient, and well adapted to local conditions.

2. Achievements of Objectives and Results

Over the 21-month implementation period, the project achieved its core technical, environmental, and economic objectives to a high degree. Starting from an almost zero baseline, Bioconvision successfully developed, validated, and scaled a waste-based insect farming system that is now fully operational, commercially active, and scientifically grounded. The

milestone framework (M1–M11) proved effective in guiding progress from early experimentation to stable operations and initial replication efforts.

Technical Objectives

The primary technical objective was to establish a reliable Black Soldier Fly reproduction and waste treatment system capable of operating at scale under local Ugandan conditions. This objective was fully achieved.

By the end of Phase I, a stable reproduction system was in place, producing sufficient quantities of young larvae to support waste treatment without becoming a bottleneck. This marked the transition from experimental breeding to continuous operation. Waste treatment capacity expanded steadily from small-scale trials to multi-ton daily processing, supported by improved site layouts, greenhouse structures, and biopond designs. The system demonstrated flexibility across a wide range of waste streams, including food waste, water hyacinth, brewery waste, bakery waste, fish waste, and agro-industrial residues.

Despite infrastructure delays and external constraints, core breeding and treatment operations remained uninterrupted throughout the project period, confirming the robustness and adaptability of the system under real operating conditions.



Treatment Unit, balancing different organic waste streams to create a suitable feeding substrate

Environmental Objectives

A central environmental objective was to demonstrate that waste-based insect farming can deliver meaningful climate benefits. This objective was largely achieved, supported by operational data and scientific analysis.

The project demonstrated that emissions from the insect conversion process are minimal compared to the methane emissions avoided by diverting organic waste from open landfills.

Current calculations indicate a strong net avoidance effect when compared with prevailing waste management practices in Jinja. Based on these findings, all larvae products produced during the project qualify as Net Zero Protein Feed and are very likely carbon-negative in net terms.

Further scientific validation is underway through a full life cycle assessment conducted as part of a PhD project at Makerere University, using real operational data from the site. While a third-party carbon audit is not yet feasible at the current scale due to cost, the project has established the necessary data collection and documentation systems to remain audit-ready as scale increases.

In addition, an Environmental and Social Impact Assessment was conducted as part of the project's responsible scale-up process. The assessment confirmed that the project's overall effects are positive, particularly through improved organic waste management, while also identifying standard mitigation measures for operational risks typical of waste handling and agri-processing sites.

Economic and Market Objectives

The project also aimed to demonstrate economic viability by converting waste into marketable products and generating revenue. This objective was partially achieved and clearly validated.

First sales of both insect-based feed and organic fertiliser were achieved early in the project and increased steadily over time. Fertiliser demand proved seasonal, aligning with Uganda's rainy seasons, while larvae sales showed strong uptake among poultry and aquaculture producers. Feeding trials demonstrated clear productivity gains, including faster growth and shorter production cycles when insect-based feed replaced part of conventional feed.

In parallel, the project secured long-term concessional financing that exceeded the originally planned amount, providing financial stability and enabling continued scale-up. While not all targeted sales volumes were fully reached within the project period, market acceptance was clearly demonstrated, pricing dynamics became better understood, and demand patterns were established and continue to show positive momentum.

Partnerships and systematic Impact

Beyond site-level operations, the project initiated broader system integration through partnerships across the waste and agricultural value chain. Organic waste is now sourced from fruit processors, breweries, fish processors, bakeries, markets, farms, schools, restaurants, and hotels. This diversity ensures a stable waste supply, reduces dependency on single sources, and strengthens logistical resilience, demonstrating that the system can be flexibly integrated across sectors and waste types.

In parallel, the project created a functioning market for segregated organic waste by consistently purchasing sorted material. This introduced clear economic incentives for waste segregation while maintaining low entry barriers, enabling informal waste pickers, small contractors, and community-based collectors to participate, improve sorting practices, and access more predictable income opportunities. In addition, the original site evolved into a combined sales, demonstration, and training space, where practical knowledge is shared directly with farmers, waste handlers, and other stakeholders.

Know-How Transfer and Capacity Building

During the course of the project, workshops took place continuously in various forms and formats, reflecting the diversity and maturity of the emerging insect farming sector.

The formats ranged from intensive 14-day deep-dive trainings with full practical immersion, to focused half-day introductory sessions tailored for first exposure. Participants came from different backgrounds and geographies: from large international delegations to local and regional groups of enthusiastic smallholder farmers exploring insect farming as a new livelihood opportunity.

Most of the trainings were conducted independently by Bioconvision. Selected sessions were implemented jointly with our partners, most notably with EAWAG under the SOR4D framework, as well as with PREVENT Waste Alliance and the Climate and Clean Air Coalition (CCAC). These collaborations strengthened the technical depth and broadened the outreach of the program.

Beyond technical instruction, the training sessions serve a broader purpose. They are essential not only for transferring practical knowledge on waste-based insect farming, but also for shifting perceptions. Waste-based production is often misunderstood as a “dirty” activity. Through hands-on exposure at our reproduction and treatment sites, participants experienced first-hand that the process is structured, hygienic, and professionally managed. The narrative changes from a low-value waste business to a clean, efficient upcycling process that yields superior agricultural products.



BSF Practitioners Workshop with ECLOSE, EAWAG and PREVENT Waste Alliance, Oct 2025

Improve Livelihood for Women

Bioconvision has prioritized female employment. All employees receive formal work contracts, including statutory social security contributions and clearly defined employment terms. For most of our staff, this represents their first entry into the formal labour market. Transitioning from informal or irregular income sources into structured employment provides financial stability, legal protection, and access to social security benefits.

In addition to formal employment, Bioconvision actively supports education. We pay school fees targeted at daughters of employees, as well as for staff members who wish to complete their own formal education. This ensures that employment not only generates income, but directly contributes to personal development.

We also provide access to basic healthcare. By supporting employees in accessing essential medical services, we reduce the risk of health-related income shocks and strengthen overall household resilience.

During the course of the project, we have mobilized direct payments of 41 million UGX for school fees and medical bills alone, on top of regular salaries and statutory social security contributions.

Overall Assessment

Overall, the project met its objectives to a high degree across technical, environmental, economic, and social dimensions. Technically, a resilient and scalable Black Soldier Fly system was established, covering the full insect lifecycle and operating reliably under local conditions. Environmentally, the project generated strong evidence for climate mitigation through organic waste diversion and low-emission insect-based feed production. Economically, it demonstrated clear market demand for both insect-based feed and organic fertiliser, generated sustained revenues, and secured long-term financing to support continued growth.

The remaining gaps relate primarily to scale rather than feasibility and can be addressed beyond the project timeline. These gaps are mainly linked to volumes, timing, pricing, economies of scale, and verification requirements, rather than to technical limitations or a lack of market acceptance. Crucially, the project has reduced uncertainty where it mattered most at the outset: the biological system works, waste supply can be organised, products can be sold, and value can be created locally.

As a result, the project leaves behind more than a functioning production facility. It has established a proven operating model, a trained team, stable partnerships across the waste and agricultural value chain, and a growing market for both inputs and outputs. These foundations position Bioconvision to continue scaling responsibly, deepen its environmental and social impact, and serve as a practical reference point for waste-based insect farming in comparable urban contexts across the region.



Breeding Unit, Black Soldier Fly Larvae at different development stages

Summary Table: Objectives, Milestones, and Achieved Results

Objective Area	Original Objective	Milestones	Achieved Results	Evidence / Indicators
Technical – Reproduction System	Establish a stable BSF reproduction system capable of supplying larvae at scale	M1, M4	A reliable and flexible BSF reproduction unit was established and scaled. Continuous production of 5-day-old larvae was achieved and production volumes can be adjusted to waste availability.	Stable daily larvae output; uninterrupted breeding across all phases; successful scale-up from pilot to larger facility
Technical – Waste Treatment	Develop and operate a waste-based insect waste treatment system	M2, M5, M8	Waste treatment scaled from pilot trials to multi-ton daily capacity. The system successfully processes a wide range of organic waste streams and performs reliably under real operating conditions.	Daily processing of several tons of waste; multiple treatment units operational; diversified and stable waste sourcing

Production Outputs	Convert waste into marketable protein feed and organic fertilizer	M3, M6	Continuous production and sale of fresh larvae, dried larvae, and organic fertilizer. Conversion rates stabilized and production aligned with market demand.	Cumulative sales volumes achieved; repeat customers; confirmed orders and sales pipeline
Environmental – Climate Impact	Demonstrate climate mitigation through waste diversion and low emissions	M9, M10	The BSF conversion process generates minimal direct emissions while avoiding substantial methane emissions from landfilling. All larvae products qualify as Net Zero Protein Feed.	GHG calculator developed; avoidance effect demonstrated; third-party verification once scale allows.
Economic – Market Validation	Demonstrate demand and revenue potential for BSF products	M3, M6	Clear market acceptance for both insect-based feed and organic fertilizer was demonstrated. Demand patterns and pricing dynamics are understood and continue to show positive momentum.	Sales volumes achieved; feeding trials with measurable productivity gains; growing and recurring customer base
Objective Area	Original Objective	Milestones	Achieved Results	Evidence / Indicators
Economic – Financing	Secure financing for scale-up and long-term operations	M7	Long-term concessional financing was secured, providing financial stability and enabling continued scale-up.	Signed long-term loan agreement; disbursements for infrastructure and expansion
Partnerships & System-Level Impact	Integrate the BSF system into broader urban and agri-food value chains	M8, M11	Different partnerships were established across the waste and agricultural value chain. Organic waste is sourced from fruit processors, breweries, fish processing facilities, bakeries, markets, farms, schools, restaurants, and hotels, enabling resilient logistics and system integration.	Multiple waste sourcing agreements; successful processing of heterogeneous waste streams; diversified partner base

Circular Economy & Social Impact	Improve livelihoods and incentivize sustainable waste management	Cross-cutting	A functioning market for segregated organic waste was created with low entry barriers. This incentivized waste segregation, improved waste quality, and provided income opportunities for informal collectors and small contractors.	Regular purchase of sorted waste; increased participation of waste pickers; improved waste quality and supply stability
Replication & Leverage	Demonstrate applicability of the model beyond the core site	M11	Practical replication pathways were tested through partnerships, applying the BSF model to external waste streams and returning value to agricultural users.	Successful treatment of external waste streams; operational partnerships in place; pathways for further replication identified
Capacity Building & Knowledge Transfer	Build local skills and sector capacity	Cross-cutting	The original site evolved into a combined sales, demonstration, and training space, supporting practical learning for farmers, waste handlers, and other stakeholders.	Training activities conducted; demonstration facility operational; growing engagement from external stakeholders

3. Multiplication / Replication Preparation

From the outset, the project was designed with replication in mind. Rather than concentrating all activities in a single, large treatment facility, Bioconvision explored a decentralised waste treatment logic supported by centralised larvae production. The underlying rationale is straightforward and practical: organic waste is bulky, wet, and costly to transport over long distances, while young larvae are lightweight, compact, and easy to move. Transporting larvae to the waste, rather than transporting waste to a central treatment site, offers clear advantages in terms of logistics, costs, emissions, and overall scalability.

Within the project framework, the technical and operational foundations for this approach were established. A stable and flexible larvae reproduction system was developed, capable of producing young larvae in consistent quality and quantities. In parallel, treatment processes were standardised and tested across different waste streams, allowing treatment units to be designed in a modular manner and adapted to local waste characteristics. Together, these elements form essential prerequisites for decentralised deployment.

As a concrete preparatory step, the project initiated planning for a decentralised treatment facility in partnership with a large fruit processor located in the greater Kampala area. The concept foresees a treatment unit built adjacent to the processing facility, enabling fruit waste to be treated on site using Black Soldier Fly larvae supplied from Bioconvision's central reproduction unit. Preparatory discussions, process design, and site planning were initiated during the project period, laying the groundwork for implementation beyond the core project sites.

In parallel, the project further developed the concept of a franchise-style replication model, although it was not implemented within the project timeline. The idea is to enable trained individuals emerging from Bioconvision’s own training activities to become independent waste treatment entrepreneurs. Under this model, Bioconvision would support franchisees by designing their treatment facilities, supplying young larvae on a long-term basis, and creating reliable market access for the outputs, including a buy-back option for organic fertiliser. Waste sourcing, day-to-day operations, and treatment would remain the responsibility of the franchisee, ensuring local ownership and accountability.

The project deliberately did not rush the implementation of this model. Experience during the project showed that successful decentralised waste treatment requires not only technical readiness, but also entrepreneurial maturity, operational discipline, and confidence on the part of potential franchisees. Building such an ecosystem takes time. The project therefore focused on laying solid technical, operational, and market foundations, while allowing future franchisees the space needed to gain experience, skills, and trust in the system.

4. Impact / Sustainability

Ecological	Unit	At the REPIC Project's Completion
Installed renewable energy capacity	[kW]	None
Renewable energy produced	[kWh]/year	None
Amount of fossil fuel energy saved	[kWh]/year	None
Greenhouse gas reduction	[t CO ₂ -eq]/year	936 t CO ₂ -eq / year
Newly collected and separated waste	[t]	985 tons
Newly recycled waste	[t]	985 tons (100%)
Economic		
Energy costs (LCOE)	[ct/kWh]	n/a
Triggered third-party funding/investments	[CHF]	CHF 200'000
Local private income generated	[CHF]	CHF 45'000
Social		
Number of beneficiaries	[Number]	500-600 beneficiaries
Number of new jobs	[Number]	16 full time positions
Number of trained personnel	[Number]	200-300 participants

Greenhouse gas reduction

The greenhouse gas reduction figures are based on a dedicated greenhouse gas calculator developed as part of a Master's thesis at EPFL in collaboration with EAWAG. The calculator quantifies the direct emissions generated by Bioconvision's operations, covering both larvae reproduction and waste treatment activities, and compares them with the emissions that would occur if the same organic waste were disposed of at the local open landfill.

The results show that waste-based insect farming avoids up to 950 kg CO₂-equivalent per ton of waste treated, considering only waste streams that would otherwise be landfilled, primarily food waste. Based on Bioconvision's actual waste inflows in 2025, a conservative estimate indicates that approximately 936 tons of CO₂-equivalent emissions were avoided during the year. At full operational scale, this avoidance potential could increase to up to 3'800 tons of CO₂-equivalent per year.

Newly collected, separated and recycled waste

The amount of newly collected waste is derived from our operational records. On average, Bioconvision collected approximately 2.7 tons of segregated organic waste per day, operating year-round. Over 365 days, this corresponds to approximately 985 tons of newly collected waste.

In 2025 alone, this volume translated into around 83 tons of marketable organic fertilizer and approximately 60 tons of fresh larvae. The larvae were sold fresh, processed into dried larvae, or reintegrated into our reproduction system to sustain production capacity.

Bioconvision operates a fully closed-loop, 100% waste treatment system. Only pre-segregated organic waste is accepted, rejection rates are negligible, and all incoming waste is converted into marketable products. The quantity of newly recycled waste therefore equals the quantity of newly collected waste — making Bioconvision a zero-waste facility.



Treatment Unit, different waste streams

Energy costs (LCOE)

Energy costs are based on the commercial electricity tariffs of the Ugandan national grid. The reported levelised cost of energy of approximately CHF 0.12 per kWh reflects the effective cost of grid electricity faced by commercial users.

Triggered third-party funding and investments

Triggered third-party funding refers to a concessional loan of CHF 200'000, which was secured during the project period. The loan is fully repayable over a period of seven years and is used to finance infrastructure development and scale-up activities. This financing was mobilised as a direct result of the project's progress and demonstrated operational viability.

Local private income generated

Local income generation is calculated based on direct sales revenues from insect-based feed and organic fertiliser. During the project period, Bioconvision generated approximately UGX 206 million in sales revenue. Using current exchange rates, this corresponds to around CHF 45'000 in locally generated private income.



Revenue Generation, Shipment of fertilizer products

Number of beneficiaries

Estimating the number of beneficiaries requires a differentiated approach. In waste sourcing, Bioconvision works with aggregators who, in turn, coordinate gatekeepers, sorters, and waste pickers. An estimated 45 individuals are directly involved in daily waste sourcing activities.

Livestock farmers purchasing insect-based feed do so through purely commercial transactions and are therefore not counted as beneficiaries. However, through targeted partnerships, 45 poultry farmers and 72 fish farmers, primarily youth groups, benefited from access to insect-based feed at subsidised rates.

On the crop side, Bioconvision's organic fertiliser is distributed through partnerships with large coffee processors. These partners reported that approximately 300–400 coffee farmers have improved yields through access to the fertiliser.

Employment and training

The project created 16 full-time positions at Bioconvision, spanning production, waste logistics, administration, and sales. In addition, training and capacity-building activities conducted at the site reached an estimated 200–300 participants, including staff, farmers, waste handlers, and other stakeholders exposed to insect farming and waste-based circular economy practices.

Outlook / Further Actions

1. Multiplication / Replication

Bioconvision prioritises consolidation before rapid expansion, ensuring that multiplication is built on proven systems, stable markets, and strong operational discipline.

The first priority is to fully leverage and further develop the existing infrastructure in Jinja. While the core technical systems are in place and operating reliably, the current focus is on reaching the site's full designed capacity of treating up to 5'000 tons of organic waste per year. This requires continued optimisation of waste logistics, larvae production efficiency, staffing routines, and market access for both insect-based feed and organic fertiliser, alongside the mobilisation of further infrastructure investments. Achieving this level of utilisation is critical, as it allows fixed costs to be absorbed, operational learning to mature, and financial performance to improve before any further geographic expansion.

Once this level of consolidation is achieved, the strategy shifts from local scale-up to regional replication. Rather than expanding treatment capacity further at the Jinja site, Bioconvision plans to establish the next commercial treatment facility following the decentralised waste-treatment model developed during the project. A suitable partner for the next site has already been identified, and initial planning is underway. The treatment unit will be located close to a major waste generator, allowing organic waste to be treated on site using young larvae supplied from the central reproduction facility. This approach minimises transport costs and emissions while enabling faster and more flexible deployment.

Experience from the project has shown, however, that successful replication cannot be rushed. The main challenge is not technical feasibility, but synchronisation and timing. Insect farming operates as a just-in-time system in which larvae production, incoming waste volumes, and sales of fresh larvae must scale simultaneously. Any imbalance – too many larvae without sufficient waste, too much waste without enough larvae, or insufficient market demand for fresh larvae – can destabilise operations. Managing this interdependence requires careful planning, reliable data, and operational experience, all of which take time to develop.

2. Impact / Sustainability

During the multiplication phase, the project is expected to generate sustained impacts across environmental, socio-economic, and resource-efficiency dimensions.

From an environmental perspective, scaling decentralised treatment units will increase the volume of organic waste diverted from open landfills. Each additional site applying the BSF model contributes to methane reduction while producing low-emission, locally sourced insect-based feed and organic fertiliser. As regional treatment capacity expands, cumulative greenhouse gas avoidance will grow well beyond what a single centralised site can achieve.

In terms of resource efficiency, the decentralised model treats waste close to its point of generation, reducing transport distances, fuel use, and associated costs. Centralised larvae production ensures biological quality and consistency, while decentralised treatment maximises logistical efficiency. Together, these elements create a scalable circular system in which waste, nutrients, and value remain within local and regional economies.

The socio-economic impact is equally significant. Each new treatment unit creates direct employment and stimulates demand for segregated organic waste, strengthening sorting practices and stabilising incomes along the waste value chain.

Overall, the project demonstrates that successful waste-based insect farming in African contexts depends less on scale alone and more on contextual fit. By expanding gradually, building strong partnerships, and aligning biological systems with real market demand, Bioconvision aims to deliver durable and scalable impact without relying on capital-intensive industrial models.



Waste Treatment Site in Mafubira

Main Findings and Conclusions

One of the central findings of the project is that the Black Soldier Fly sector is often framed too narrowly, shaped by two dominant but contrasting approaches. On the one hand, there are low-tech waste management solutions that prioritise waste reduction but tend to deliver heterogeneous and often low-value outputs. On the other hand, the sector is increasingly characterised by highly capital-intensive industrial insect protein facilities designed for export-oriented, tightly regulated markets. Through this project, Bioconvision has demonstrated that there is a viable and highly relevant alternative between these two extremes: a “missing middle” that combines operational simplicity with product quality and commercial discipline.

The project showed that it is possible to produce high-quality, consistent farm inputs for local and regional markets using a low-tech, low-capex system architecture. Rather than optimising for maximum automation or industrial-scale protein output, the focus was placed on system robustness, biological stability, and close alignment with local market demand. This approach proved particularly effective in operating environments where infrastructure reliability is uneven, access to capital is constrained, and labour availability is high.

A further key conclusion is that “Africa-fit” system design is not about compromise, but about intentional choices. Throughout the project, constraints such as limited capital, fluctuating power supply, and complex waste logistics were treated not as temporary obstacles to be engineered away, but as stable design parameters. By leveraging locally available organic waste streams, labour-based processes, and phased investment, the project aligned growth with cash flow and operational learning. The result was a system that is commercially viable at smaller scales, resilient to shocks, and adaptable to different local contexts.

Recommendations for Similar Projects

First, strategic positioning matters as much as technology. Projects should avoid attempting to replicate either informal low-tech waste solutions or fully industrial insect protein models without critically assessing their suitability for local conditions. A mid-scale, quality-focused approach that balances simplicity with operational discipline can offer a more realistic pathway to sustainability and replication.

Second, decentralisation should be considered early in system design. Transporting larvae rather than waste, deploying modular treatment units, and building partnerships close to waste generation points can significantly reduce logistical complexity and costs. At the same time, decentralisation requires strong central functions, particularly for larvae production, quality control, and market access.

Third, replication is as much a social and entrepreneurial process as a technical one. While systems and blueprints can be developed relatively quickly, building confident and capable operators takes time. Training, demonstration, and gradual exposure to operational responsibility are essential before decentralised or franchise-style models can succeed.

Finally, environmental claims must be grounded in operational data and scientific collaboration. Early engagement with research partners enabled the project to build a credible evidence base for climate impact, while remaining realistic about the timing, costs, and requirements of formal certification.

Personal Observations and Reflections

One of the most striking observations during the project was how quickly theoretical distinctions between “waste management” and “feed production” dissolve in practice. On the ground, value is created not by labels, but by systems that function reliably day after day, deliver consistent outputs, and integrate smoothly into existing economic relationships. Farmers, waste collectors, and buyers were less concerned with whether the system was framed as climate innovation or waste infrastructure, and more interested in reliability, price, and tangible benefits.

Another important insight was that simplicity is often a strength rather than a weakness. Systems built around local materials, manual processes, and incremental improvements proved easier to maintain, adapt, and stress-test than highly engineered solutions. Rather than failing under variability, these simpler systems benefited from it: disruptions exposed weak points early, adjustments could be made quickly, and learning was embedded directly into daily operations. This design logic fostered a strong sense of ownership among staff and partners, who were able to understand, influence, and improve the system rather than merely operate it. Over time, this combination of simplicity and antifragility resulted in a production setup that became more reliable through use, change, and exposure to real-world conditions.

Overall, the project reinforced the conviction that successful Black Soldier Fly deployment in Africa will not come from copying models developed elsewhere, but from designing systems that start from local realities and build outward. The “missing middle” is not a compromise between ambition and feasibility; it is a deliberate strategic choice that offers a credible and scalable pathway for insect farming to contribute meaningfully to circular economies, food security, and climate resilience in the region.

