

The BUGS Project: Technical Reflections from the Adama BSF Workshop

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Introduction

In December 2025, Abraham Eshtie participated in a hands-on workshop on Black Soldier Fly (BSF) technology in Adama, Ethiopia, under the **BUGS Project** (Biomass Utilisation by Insects for Green Solutions in Africa). This project, funded by the **PREVENT Waste Alliance** and the **Climate & Clean Air Coalition**, provided a deep dive into the operational realities of insect-based circular economies. What follows is the full, unedited technical transcript of Abraham's reflections on the transition from theory to industrial practice.

1. The “Aha!” Moment: From Linear Theory to Systemic Reality

The Inquiry: *In theory, the BSF lifecycle looks straightforward: collect waste, feed larvae, and harvest. Was there a specific stage that proved more complex in practice?*

Abraham's Reflection: In theory, the BSF lifecycle is often presented as a simple linear progression. My initial understanding heading into the Adama workshop was exactly that. However, standing on the farm and working directly within the system, I realized how much nuance exists beneath that simplicity. For me, the most complex part was not a single stage, but the realization of the delicate, interconnected nature of the entire system—and its profound promise for farmer independence.

Touching the larvae by hand, counting them, and feeling the metabolic heat generated during the pre-pupae's metamorphosis provided a sensory education that no textbook can replicate. Measuring substrate and being "in the dirt" showed me how tiny variables significantly impact the outcome. It became clear that this is a serious, sophisticated industry requiring the active management of biological conditions.

Black Soldier Flies are not just insects; their feeding, growth, reproduction, and movement function as a purposeful system. You must learn to work *with biology*, not simply attempt to

control it. This shifted my perspective from seeing BSF as a generic circular economy solution to seeing it as a delicate, responsive production unit.

Furthermore, I realized the practical power this offers. Farmers across the East African Region now have the opportunity to produce their own poultry feed and natural fertilizer. This reduces dependence on external supply chains which, as we have seen, can be unreliable during regional or global uncertainty. The fact that this can be achieved in a decentralized, DIY facility on a part-time basis is where the real power lies. I did not attend as a farmer, but as someone wanting to translate knowledge. I now see BSF as a mindset-shift tool that turns "waste" into a high-value resource.

2. The “40 kg Math”: Economics of the Urban Juice House

The Inquiry: *From a data perspective, how critical is feedstock consistency when targeting 4–8 kg larval yields in a city like Addis Ababa?*

Abraham’s Analysis: In major Ethiopian cities like Addis Ababa, Adama, Bahir Dar, and Hawassa, juice houses are the primary producers of fruit-based organic waste. This presents a perfect opportunity to analyze the numerical relationship between waste input and larval yield. A large juice house in Addis can generate up to 40 kg of organic waste on a single busy day.

In an optimal environment, 40 kg of waste should yield:

- **4–8 kg** of protein-rich larvae (10–20% conversion rate)
- **8–16 kg** of nutrient-rich frass (20–40% conversion rate)
- **50–80%** reduction in total waste volume.

However, theory only survives in an "optimal bubble." In reality, feedstock consistency is only one variable. **Moisture level** and **composition** are equally crucial.

Maintaining moisture between **60–70% (by weight)** is critical for larval movement and feeding efficiency. If the substrate is too dry, larvae grow slowly and survival rates drop. If it is too wet, the substrate becomes anaerobic, producing foul odors and promoting harmful fungal or bacterial growth.

Composition is the second pillar. We require a substrate rich in carbohydrates and protein but low in fiber (avoiding materials like heavy corn husks). It is also vital to ensure the stream is free of plastics and inorganic contaminants. During the workshop, I utilized the **Black Soldier Fly Substrate Navigator**, an essential tool for assessing the suitability of available feedstocks in real-time.

3. The Data Gap: Defining ROI in a Versatile Industry

The Inquiry: *As a data scientist, what specific metrics should practitioners track to prove "Waste-to-Value" ROI?*

Abraham's Analysis: The Adama workshop brought together PhD researchers—who study every minute metric—and farmers, who often "eyeball" the process based on lived experience. This taught me that BSF farming is so versatile that there is no "one" metric to prove ROI. The key metric depends entirely on the practitioner's purpose.

For example:

- **Smallholders in Siaya County, Kenya:** For those feeding brewer's waste to poultry and pigs, the key metric is **larval yield per kg of waste input**. This directly correlates to reduced feed costs.
- **Crop Farmers in Kisumu:** Their ROI is measured by **crop yield increase per unit of frass applied**.
- **Community Waste Collectives (e.g., Mila in Mombasa):** Their success is measured by the **total waste reduction percentage**.

If forced to pick one overarching metric for the "data nerd" in me, it would be **"Resource-to-Output Efficiency."** This measures the total value (larvae + frass) extracted from every unit of waste across all practitioner types. ROI is realized the moment organic waste is converted into any valuable product, whether that is feed, fertilizer, or direct income.

4. The Network: Overcoming Local Challenges

The Inquiry: *What was your biggest takeaway from connecting with the Ethiopian BSF network?*

Abraham's Reflection: The workshop fostered a unique synergy between three groups: institutional researchers, active "lived-experience" farmers, and climate enthusiasts.

The primary local challenges I observed are:

1. **Dispersed Networks:** Local BSF practitioners are often informal and lack proper documentation of their setups, making it hard to consolidate best practices.
2. **Information Access:** There is a significant gap in accessible information regarding local certification, regulation, and clear market demand.

However, global organizations are not overlooking these issues. Through the **Africa BSF WhatsApp community** (facilitated by Africa Circular, Eawag, and partners), we are seeing the

emergence of a platform for experience-sharing, market linkage, and collaboration. The global community is very much connected to local practitioners, helping us build a unified ecosystem.

Technical Resources Cited

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- **BSF Substrate Navigator.** (<https://bsfl-substrate-navigator.onrender.com/Once>)
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