Unmet needs

Problem Statement

Food waste, often overlooked as a tiny fragment of human life, has evolved into one of the most pressing global environmental challenges. It generates about "8-10 percent of annual global greenhouse gas (GHG) emissions – almost 5 times that of the aviation sector – and significant biodiversity loss by taking up the equivalent of almost a third of the world's agricultural land" (UNFCCC, 2024). Beyond waste disposal, emissions accumulate across the entire supply chain, including production, transportation, and eventual decomposition sectors. This full cycle significantly worsens climate change and magnifies the problem of food waste. In addition, the U.S. Environmental Protection Agency (EPA) affirms that "over one-third of the food produced in the United States is never eaten, wasting the resources used to produce it and creating a myriad of environmental impacts." For instance, the water devoted to crop irrigation simply goes to waste. The energy used during harvesting and processing never yields benefit. But beyond environmental impacts, food waste also carries significant economic and biological challenges that are urgent to address.

Economically, food waste is a major burden. The EPA also reports that the cost of food waste to American consumers averages about $728 per year and for a household of four, the annual cost is $2913, which highly contributes to the inefficiency of the economy. According to the research paper published by Katarzyna Slopiecka, a researcher at the University of Perugia, Department of Engineering, in 2022, the structured regression line indicates a negative inverse relationship between national GDP and the composition of organic food waste. This provides insights into targeting our solution towards varied socioeconomic contexts. Moreover, current solutions are limited in effectiveness and risk of introducing additional contaminants. There are emerging issues with food waste management, where a rising concern of food waste recycling containing levels of plastic and persistent chemical contaminants, including per- and polyfluoroalkyl substances (PFAS), in food waste streams.

The biological composition of food waste also poses a huge challenge for treatment. It is primarily made up of carbohydrates (41-62%), proteins (15-25%), and lipids (13-30%), and carbohydrates are further broken down into cellulose, hemicellulose, lignin, starch, and fiber (Katarzyna Slopiecka, 2022). These organic components, along with other unbreakable compounds, make up a significant portion of the total organic compounds in food waste, thus contributing to the main goal of the team's project. Those complex polysaccharides, especially cellulose and lignin, resist enzymatic degradation, which poses a challenge for Black Soldier Fly Larvae (BSFL) to digest. The insect is polyphagous, which consumes all types of organic materials of animals and plants (Bava et al., 2019), Diener et al (2011) showed that BSF can be used to convert municipal waste with a reduction rate ranging from 65.6 to 78.9%. However, the natural gut microbiota lack the enzymes needed to efficiently break down plant cell walls, which limits its digestion speed and nutrient extraction from plant-based food wastes. These limitations raise concerns about current waste management systems (both in Taiwan and globally), therefore introducing the market gap that our team, LarVase, plans to address.

Waste management market

<u>*Market Size*</u>

Taiwan and the global waste management markets are different in both scale and growth trajectory. Compared to the global market, Taiwan accounts for only a tiny portion of the global market; nevertheless, its projected growth is comparatively faster. Hence, to evaluate Taiwan's relative position in the global market, the following table shows the key metrics from 2023 to 2030, including market size, growth rate, and segment focus, etc.

Taiwan vs. Global Waste Management Market (2023-2030)

Metric	Taiwan	Global
2023 Market Size	US $9.27 billion	~US $1.36 trillion
2030 Market Size	US $16.05 billion	~US $1.97 trillion
CAGR (2023-2030)	7.1%	5.4% - 5.5%
Global share (2023)	~0.68%	100%
Key Segment	Food / Organic, Industrial	Industrial, Municipal, E-waste
Recycling Rate	~55-77% (top-tier globally)	~19.8% (avg)
Policies	Circular Economy Act, iTrash	Zero-waste, smart infrastructure
Growth Focus	Organics, BSFL, composting	Infrastructure, smart sorting

Based on the graph, Taiwan contains advanced recycling mechanics, a strong organic focus, and a high CAGR, which makes it an ideal location for LarVase's enzyme-enhanced fiber degradation solution. The market data indicate that current systems in Taiwan rely on Black Soldier Fly Larvae (BSFL), which is one of the most widely used and efficient methods for converting organic food waste into protein and composts (*Circular Taiwan Network*, 2025). However, such techniques struggle to process fiber-rich organic wastes such as vegetables, fruit peels, and cellulose-heavy scraps. Within this current biological gap in Taiwan's highly regulated system, LarVase holds the potential for local deployment and eventual scale-up.

Existing Solutions

Fiber is primarily composed of "complex, non-starch carbohydrates and lignin that are not digestible within the small intestine because mammals do not produce enzymes capable of hydrolyzing them into their constituent monomers" (Turner & Lupton, 2011). As a result, fiber is structurally tough and resistant to degradation. The most common industrial and municipal methods to process fibrous organic waste include:

Current Industrial Methods for Dissolving Fiber

Method	Description	Limitations
Composting (aerobic)	Microbial breakdown over weeks/months at moderate temps (~50-70 °C)	Slow; incomplete fiber degradation; requires space & time
Anaerobic digestion	Microbes convert organics into biogas in oxygen-free environments	Poor lignocellulose conversion; often pretreated
Thermal treatment	Incineration or pyrolysis at 500-800 °C to break complex bonds	High energy cost; destroys material value
Chemical hydrolysis	Acids/alkalis used to pre-digest cellulose before composting/digestion	Corrosive, unsafe, expensive to scale; residual chemicals
Mechanical shredding	Physically breaks plant fiber into smaller pieces to aid microbial access	Does not alter the chemical structure of cellulose
Enzymatic treatment	Uses enzymes like cellulases to break ß-1,4-glycosidic bonds in cellulose	Very effective, but high production cost without optimization

As the graph illustrates, current industrial methods for fiber degradation each come with significant limitations, such as slowness, incompleteness, energy intensity, etc. Notably, none of these methods are efficient and scalable enough for current use in BSFL-based systems, which dominate Taiwan's food waste management market. Thus, there is a clear unmet need: a lower-cost, biologically compatible solution that allows the breakdown of fibers without changing the existing infrastructure much. Our company, LarVase, fills this gap as we combine synthetic biology with targeted enzyme production, which serves as a scalable pretreatment step that directly enhances BSFL efficiency and addresses a fundamental weakness in the current system.

First Potential Customer

Given the fiber-degradation gap in Taiwan's BSFL-dominated food waste management system, LarVase's solution offers unique potential. Specifically, our enzyme solution designed through cost-effective YebF facilitated secretion offers value as a direct biological enhancement. Our initial customers are likely to fall into the following categories:

1. BSFL Farming Companies & Organic Waste Processors

Enterprises such as InnoRs, MonsterEnvironmental, Vertical Insect Farm, and other local BSFL farms processing food waste into animal feed or compost are ideal early adopters. They directly face the challenges of fiber digestion inefficiency and would benefit from a plug-in enzyme solution that improves yield without major infrastructure changes.

2. Municipal Waste Contractors / Public Private Partnerships (PPP)

City-run or contracted composting and recycling facilities under Taiwan's Environmental Protection Administration (EPA) can adopt LarVase enzymes to improve the efficiency of current organics processing streams, especially in high-volume fiber waste zones (e.g., fruit markets, food courts, agriculture clusters).

3. Zero-Waste or Circular Economy Pilot Zones

Taiwan has several government-backed sustainability initiatives, such as Taipei's Zero-Waste City program and iTrash smart waste stations. These projects are strong candidates for pilot deployment due to alignment with innovation-driven procurement and clear mandates for improving food waste recycling rates.

4. Animal Feed Manufacturers Using Food Waste Inputs
Enzymatically enhanced BSFL waste conversion can increase nutritional extraction and larval biomass, offering potential value for livestock feed producers looking to use insect-derived proteins.

Scientific & Technical Foundation

Solution

As natural restriction-destroying flora lack the enzymes required to restructure plant cell walls effectively, this contributes to their digestion rate and ability to extract nutrients from plant food waste. To address this issue, our project fills the gap by engineering a microbial system capable of producing and secreting cellulolytic enzymes that can break down the fibrous fraction of food waste prior to BSFL introduction. This pretreatment approach could shorten composting times while providing a sustainable solution to food waste accumulation.

Bacillus subtilis **JA18**

We selected *Bacillus subtilis* JA18 as the gene source for our endoglucanase due to its demonstrated enzymatic robustness: the recombinant endo-β-1,4-glucanase, expressed in *E. coli*, exhibits optimal activity at pH 5.8 and 60 °C, while maintaining remarkable stability across a broad pH range (4.0–12.0) and up to 60 °C (Liu et al., 2006). These thermal properties match the elevated temperatures (40–60 °C, occasionally approaching 70 °C in thermophilic phases) observed during food waste degradation and composting (Voběrková et al., 2020). Instead of using JA18 as our chassis organism, we cloned and expressed the endoglucanase gene directly in *E. coli* BL21, combining the stability and efficiency of the JA18 enzyme with the customizability of the *E. coli* expression system.

Endo-β-1,4-glucanase gene from Bacillus subtilis JA18 plays a key role because it produces an enzyme that cuts apart the internal bonds of cellulose. By doing this, it breaks down the plant cell wall structure into smaller sugars. This process makes fibrous material much easier to degrade, allowing microbes to use the nutrients more efficiently and helping BSFL digest food waste more effectively. Unlike exoglucanases, which cut from the ends of chains, endoglucanase works internally. It quickly shortens polymers and increases the surface area of the substrate, speeding up the overall breakdown process (Liu et al., 2006). When expressed in E. coli, this gene allows our engineered system to release active cellulase into the environment. It directly targets the fibrous part of food waste. This way, the endoglucanase gene not only helps microbial digestion but also changes plant biomass at its foundation, turning a biological bottleneck into a manageable and efficient pretreatment step.

To enable secretion of the recombinant endoglucanase, we fused the JA18 endo-β-1,4-glucanase gene with YebF, a well-characterized periplasmic protein, which we expressed in E. coli using our designed vector that can be exported into the extracellular medium via the Sec pathway. This strategy allows the cellulase to bypass cell lysis and directly accumulate outside the bacterial cell, where it can interact with the fibrous fraction of food waste. The fusion exploits the natural ability of YebF to carry heterologous proteins across the inner membrane, ensuring that the enzyme reaches the extracellular environment in an active form (Zhang et al., 2006). By using YebF-mediated secretion, we address one of the major limitations of intracellular enzyme expression—the need for costly downstream purification or artificial cell disruption—thereby making our system more efficient and practical for food waste pretreatment.

Financial Model and Economic Viability

Total Cost Estimate

In this initiative, we aim to produce and distribute a cost-effective, fiber-degrading enzyme enhanced by YebF secretion technology. To achieve scalability and impact, we assume responsibility for laboratory setup, essential equipment, and ongoing operational support. The costs outlined below reflect both fixed and variable expenses for producing the enzyme at scale as a pretreatment solution in food waste management systems, particularly in BSFL-based processing facilities. These estimates are based on Taiwan’s laboratory market prices and designed to support the enzyme’s application in industrial and municipal food waste recycling systems.

Recurring Operational Costs (Variable Costs)

Once production begins, the marginal cost of producing one liter of secreted enzyme supernatant ranges from 80–140 NTD/L, with the largest cost components being culture media (30–50 NTD/L) and packaging/QA (20–40 NTD/L). These costs are competitive when compared to traditional enzymatic solutions, due to the reduction in purification steps and use of cost-efficient media. This recurring operational structure ensures we can achieve scalability without significant increases in unit cost.

Marginal costs of producing supernatant:

Cost Component	Estimated Cost (NTD)	Notes
Media	~30-50 NTD/L	Corn steep liquor, soy flour, etc…
Utilities	~20-30 NTD/L	Electricity, water, and sterilization
Consumables	~10-20 NTD/L	Bags, filters, pH buffers
Packaging+QA	~20-40 NTD/L	Bottles, assays
Total Marginal Cost	80-140 NTD/L	-

Fixed Costs (One-Time and Annual)

The fixed cost of setting up the project is estimated at 2,180,000 NTD. This includes one-time investments in laboratory rental fees and analytical tools like DNA sequencing, as well as recurring costs such as water, electricity, and consumables.

Fixed Costs:

Cost Component	Estimated Cost (NTD)	Notes
Laboratory Cost	≤ 1,800,000 NTD	Based on the typical price of a laboratory for fully equipped lab spaces and equipment.
Raw materials	≤ 200,000 NTD	Including substrates, buffers, reagents, etc.
Consumables	≤ 80,000 NTD	Pipettes, tubes, filters, etc.
Contingency	≤ 100,000 NTD	Unexpected expenses
Total costs	~2,180,000 NTD	-

This graph provides a realistic path toward commercialization, showing that our technology is not only scientifically sound, but also financially feasible.

Financial projections

Start-up Costs (Fixed, One-Time):

Cost Component	Estimated Cost (NTD)	Notes
Laboratory Rental Fees	150,000~200,000 NTD	Based on the typical monthly rent for fully equipped lab spaces
Raw materials	200,000 NTD	Including substrates, buffers, reagents, etc.
Utilities	5000~10,000 NTD	Electricity, water fees
Analytical Testings	200,000~250,000 NTD	DNA sequencing, data analysis
Consumables	50,000~80,000 NTD	Pipettes, tubes, filters, etc.
Contingency	5000 NTD	Unexpected expenses
Total costs	545000 ~745000 NTD	-

Revenue Forecasts

- *Initial Annual Sales Volume:* We assume LarVase would achieve an annual sales volume of 50,000 Liters by the end of its first full year of operation (Year 1). Based on our marginal analysis, 50,000 Liters would generate a total revenue of approximately 150,000,000NTD.
- *Average Annual Growth Rate:* The annual growth rate of 7.0% assumes consistent growth over the 10-year forecast period. This growth rate is a blended estimate of the CAGRs for the relevant markets (organic waste recycling, enzymes, Taiwan waste management, and environmental biotechnology).
- *Pricing Consistency:* For long-term revenue projections, we assume that the price per liter will fluctuate, however, total revenue growth will be captured by growth in the size of the market and LarVase's ability to gain further market share.

Break-even analysis

We project an initial annual sales volume of 50,000 Liters, yielding ~150,000,000 NTD in revenue by the end of Year 1. Given our total marginal cost per liter (80–140 NTD) and estimated market price per liter of 3,810 NTD, this suggests strong profitability potential. We anticipate a 7% average annual growth rate, aligned with the Compound Annual Growth Rates (CAGRs) for the enzyme, organics recycling, and Taiwanese waste management sectors.

$$\text{Break−Even Point} = \frac{Fixed\ Cost}{Price\ Per\ Unit - Marginal\ Cost\ Per\ Unit} = \frac{2{,}180{,}000}{3180-140} \approx \mathbf{572.18\ Liters}$$

Scalability and Societal Impact

LarVase is more than just a product—it's a movement toward smarter, faster, and greener food waste management. By combining synthetic biology, environmental biotechnology, and innovative business modeling, we offer a scalable, enzyme-based solution to a global crisis where food waste contributes up to 10% of greenhouse gas emissions. Our enzyme supernatant accelerates fiber breakdown—filling a critical gap in Taiwan's BSFL systems, which currently struggle with cellulose-rich waste. By enabling faster, more complete decomposition, LarVase reduces methane emissions, cuts landfill loads, and supports a high-recycling, low-waste future. Additionally, through increasing the protein yield of black soldier fly larvae, our solution feeds into a more sustainable livestock feed chain—less reliant on land-intensive crops like soy. Our clear market differentiation, strong financials, and forward-thinking subscription model position LarVase as a pioneering force in the circular economy.

Marketing and Customer Engagement

Marketing Strategies

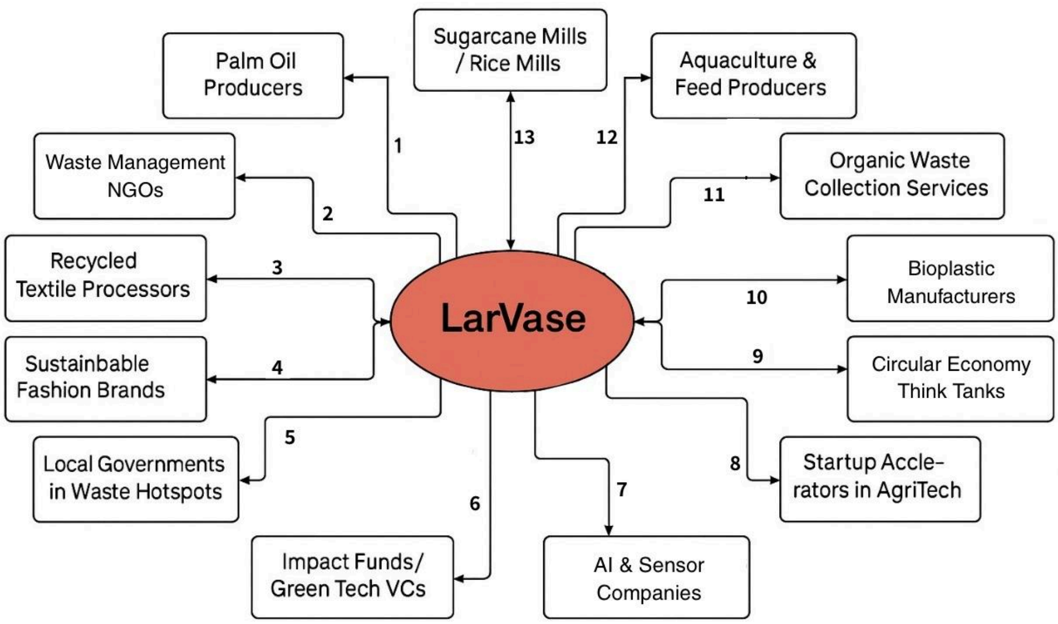
Our pricing strategy will be a combination of Cost-Plus Pricing and Value-based strategy. A traditional Cost-Plus Pricing strategy adds a fixed profit margin on top of the average costs of production, whereas a Value-Based strategy is based on data sets proving our product's benefits, therefore raising the pricing.

For our marketing strategy, we add a fixed profit margin on top of production costs. Due to our enzymes having a relatively lower cost than most commercial enzymes, our company generates a greater profit margin compared to other companies in the industry. This fixed margin is determined by the value-based strategy, where we picked a slightly higher price compared to commercial enzymes. Our product has a higher degradation speed of food waste, specializing in breaking down fibers that black soldier fly larvae can't degrade. Besides this benefit, an additional benefit from this supernatant is the change of black soldier flies it brings. The theory of the supernatant is to pre-treat food waste. Since the pretreated food waste is then digested by black soldier flies, by adding supernatants, this influences the diets of these insects, which further shows a direct impact. By applying supernatants, the black soldier fly larvae grow a higher proportion of proteins, making it a high-protein food source for livestock. Through both pricing strategies, we are able to generate great revenue from this product.

Stakeholders

While our first potential customers (listed in the "unmet needs" section), including BSFL farms, municipal processors, and zero-waste pilot zones, address immediate local unmet needs identified in Taiwan's organic waste management system, we are also actively identifying and evaluating a broader range of stakeholders. These include both domestic and international actors across public, private, and academic sectors.

Stakeholder Map



1. Supply palm fiber residues as feedstock for LarVase's BSFL system, increasing larval lipid content for biodiesel extraction and enabling valorization of agricultural waste.
2. Collaborate with LarVase to implement decentralized enzyme-based waste treatment in low-resource communities.

3. Adopt LarVase's enzymes to replace hazardous fiber-softening practices in fabric treatment, reducing dependency on child labor and toxic chemicals in low-resource textile industries.
4. Partner with LarVase to create circular solutions by turning organic waste from fashion operations into protein or fertilizer.
5. Integrate LarVase's enzyme systems in municipal organic waste treatment programs to reduce landfill pressure and emissions.
6. Integrate LarVase's enzyme systems in municipal organic waste treatment programs to reduce landfill pressure and emissions.
7. Co-develop real-time monitoring tools with LarVase to optimize BSFL growth and enzyme efficiency across input variables.
8. Co-develop real-time monitoring tools with LarVase to optimize BSFL growth and enzyme efficiency across input variables.
9. Promote LarVase as a case study or model for scalable circular bioeconomy innovations in urban and rural settings.
10. Utilize LarVase-purified cellulase to break down agro-waste into fermentable sugars for sustainable biopolymer production, closing the loop between waste valorization and green materials.
11. Serve as sourcing partners for LarVase's raw waste inputs, creating a steady pipeline of feedstock for BSFL rearing and enzyme application.
12. Incorporate protein-rich BSFL larvae enhanced by LarVase enzymes into sustainable fish and livestock feed.

Cultural Acceptance

Although public awareness of GMOs in Taiwan is relatively high, understanding of synthetic biology remains limited (Yeh et al., 2025), and many consumers express concerns about health and environmental implications. This presents an opportunity: LarVase's product is a purified cellulolytic enzyme, not a live GMO organism, and therefore avoids much of the public and regulatory resistance typically associated with GM solutions.

To further build public trust and institutional support, LarVase aligns with the national direction set by Taiwan's 5+2 Innovative Industries Plan, proposed in 2016 as "the central driver of Taiwan's industrial growth in the next era" (Executive Yuan, 2016). The plan emphasizes seven strategic pillars—including "biomedicine … and the circular economy"—and offers targeted support for startups and R&D in these fields. LarVase, as a biotech startup, qualifies for these incentives. In particular, the YebF secretion method streamlines production, reducing purification costs and shortening time-to-market, which is an ideal match with government schemes designed to accelerate translational biotech from lab to industry.

By positioning our purified enzyme within Taiwan's high-priority biotech and circular economy agenda, we strengthen:

- Product ~ market credibility: alignment with national innovation priorities
- Access to funding & infrastructure: through SME, biotech, and recycling grants
- Scalable deployment channels: via science parks and government programs
- Regulatory ease: clean, non-GMO product minimizes public resistance

Business and Product Development Roadmap

In order to ensure LarVase's long-term viability, we have developed a five-year business roadmap. The five-year horizon reflects the typical timeline for a biotech product to progress from lab validation to full market integration. This roadmap serves as a precise tool to manage the time-bound development while proactively addressing both the positive and negative long-term impacts of our solution.

Year 1: Laboratory Validation and Enzyme Purification Protocols

- Optimize and scale up the YebF-assisted secretion system in E. coli to maximize cellulase yield and purity.
- Establish standard operating procedures for enzyme purification without residual GMOs.
- Conduct compositional analysis to confirm the enzyme is free of host DNA or viable cells.
- Begin initial dialogue with Taiwan FDA regarding classification as an industrial enzyme, not a food additive or GMO.
- Identify and secure partnerships with BSFL farms for pilot-scale application.

Year 2: Field Trials and Environmental Testing

- Deploy field trials at BSFL farms using varied food waste substrates and regional conditions.

- Measure performance indicators: decomposition speed, larvae biomass, oil content, and methane emission reduction.
- Begin application for registration as a biotechnological agent under Taiwan's Environmental Agents Control Act or Agricultural Chemicals Regulation, if applicable.
- File for intellectual property protection on the production method and formulation.
- Begin Taiwan Small Business Innovation Research (SBIR) grant application for industrial scale-up.

Year 3: Regulatory Submission and Pilot-Scale Manufacturing

- Submit enzyme product application to Taiwan EPA under "industrial enzyme" classification and to COA for agricultural waste treatment use, in compliance with current microbial product guidelines.
- Confirm non-GMO classification under Taiwan FDA biosafety guidelines and notify the National Biotechnology Research Park.
- Construct pilot-scale manufacturing units within an approved science park zone to comply with industrial wastewater, labor, and GMP standards.
- Apply for regulatory pathway clarification in one export market (e.g., Vietnam, Thailand) through local legal counsel.

Year 4: Controlled Market Release and Post-Market Surveillance

- Begin controlled commercial sales to registered BSFL operators within Taiwan under existing waste processing and agri-feed regulations.
- Implement legal contracts covering liability, application instructions, and limits of use.
- Collect user performance data and conduct third-party verification of biodegradation metrics under ISO 17025-certified labs.
- Monitor compliance with Taiwan's Industrial Waste Disposal Act and document the enzyme impact on BSFL residues used in feed or soil.

Year 5: Regional Expansion and Legal Risk Management

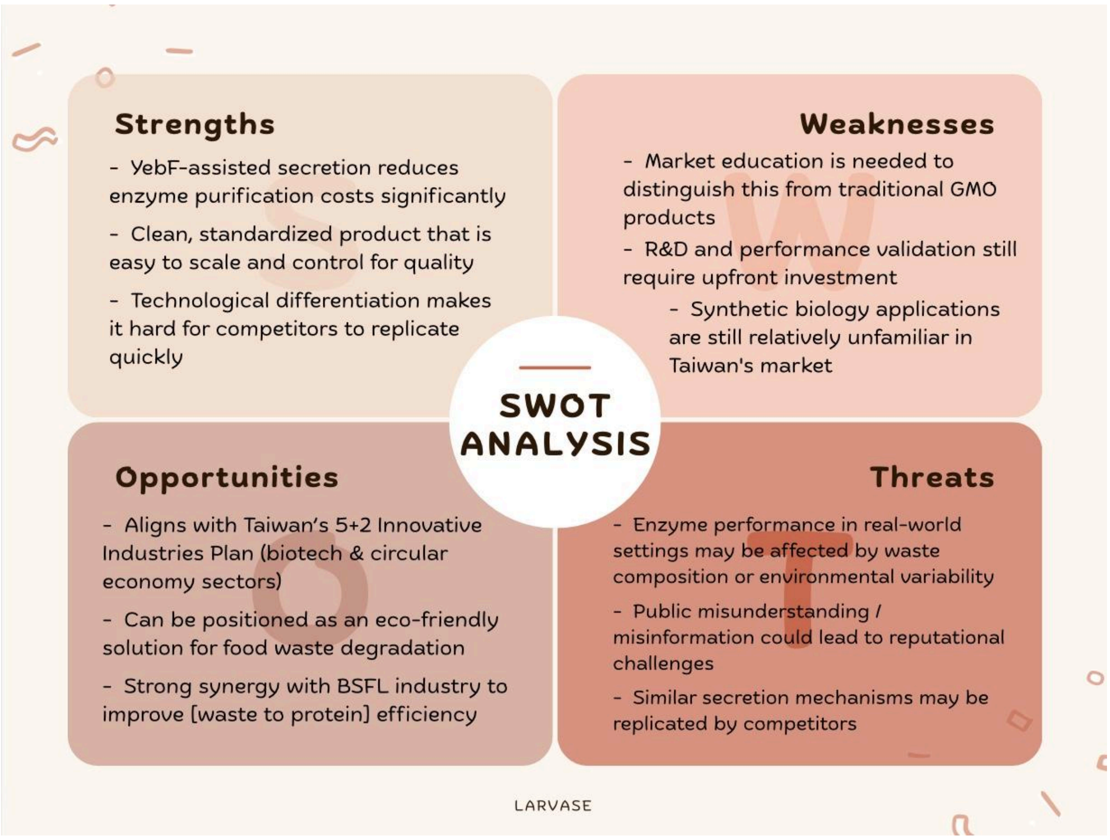
- File for product registration or recognition in two ASEAN markets with defined circular economy or insect protein policies.
- Begin documentation for compliance with OECD Test Guidelines (Sections 4 and 5) and FAO enzyme evaluation standards.

- Procure liability insurance and draft licensing contracts covering domestic use and limited regional exports.

SWOT analysis

To gain a deeper understanding of the strengths and challenges of our project, we conducted a SWOT analysis. This tool allows us to evaluate the internal and external factors that may influence the success of our product. We aim to be better equipped to strengthen our positioning within the bio-based waste management sector and address potential risks during development and commercialization.

SWOT Analysis Diagram



ERRC Grid

Action	Factor
Eliminate	- Use of native enzyme-producing microbes (e.g., *B. subtilis*) - Use of live microbial cultures - Bulky CBMs in cellulases
Raise	- Enzyme expression yield and purity - Product stability and ease of use - Commercial readiness for non-scientific users
Reduce	- Cost and complexity of enzyme production - Environmental and biosafety risks - Misfolding and degradation of proteins
Create	- Engineered enzyme kits for BSF and cellulose-rich waste - Targeted synergy with BSF digestion - BioBrick-standard enzyme products - Accessible products for low-tech users

Risk Analysis

The development timeline outlined in our business and product development roadmap is ideal, but it might face unexpected challenges due to technical and operational risks. As with many biotech startups, problems can form during the transition from lab research to real applications.

The first risk lies in laboratory optimization and yield consistency. While preliminary results support the effectiveness of the YebF-facilitated secretion system, enzyme output levels may vary under different growth conditions or expression hosts. A delay in optimizing yield could stall downstream testing. To mitigate this, we will conduct parallel testing with multiple E. coli strains and secretion constructs, while setting performance benchmarks for enzyme recovery and activity early in the development process.

The second risk involves scaling up purification. While YebF improves secretion, maintaining enzyme quality and activity at pilot and industrial scales is not guaranteed. Enzyme degradation during recovery or formulation could limit effectiveness. We will conduct early pilot-scale runs to identify issues in cost, purity, and stability. If needed, we will adjust fermentation conditions or add post-processing steps.

Third, real-world integration with BSFL systems adds environmental uncertainty. Variations in food waste composition, temperature, or microbial competition may reduce enzyme performance. To address this, we will conduct field trials with BSFL farms using different substrates. If efficacy declines, we will analyze performance data to identify key limiting factors, then iteratively adjust enzyme concentration, modify application intervals, or develop region-specific formulations based on local environmental parameters.

Conclusion

The market analysis has highlighted a critical and growing challenge in Taiwan's circular economy: the inefficiency in processing cellulose-rich food waste through Black Soldier Fly Larvae (BSFL) systems. This inefficiency limits protein yield, slows bioconversion, and creates operational bottlenecks for both public and private waste processors. LarVase offers an enzyme-based solution to overcome these barriers, which is scientifically robust, economically viable, and environmentally beneficial.

Our product (purified cellulolytic enzyme produced using a YebF-assisted secretion pathway) avoids the high purification costs common to enzyme production. This positions us to supply the BSFL industry with an affordable, scalable additive that enhances larval digestion of fibrous waste, thereby improving waste reduction rates and feed conversion efficiency. Through strategic market segmentation, we have identified two primary deployment models: integration with existing BSFL biowaste infrastructure, or targeted collaborations with municipal food waste contractors and agri-tech startups. The financial models show that even a modest increase in conversion efficiency can translate into significant economic and environmental gains. Ultimately, LarVase has the potential to transform how food waste is managed in Taiwan and beyond, turning organic refuse into sustainable value while reducing environmental harm.

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