# Chapter 1

# Introduction

## 1.1 Background

Rapid population expansion, urbanization, and increased consumption have all contributed considerably to the global increase in municipal solid waste creation. Organic waste makes up a sizable amount of this waste stream and is mostly created by households, food outlets, marketplaces, and agricultural operations. In many developing nations, waste management systems have struggled to keep up with the rising volume, leading in inefficient trash collection, overreliance on landfills, and rising environmental contamination (Yudartha et al., 2026). The buildup of organic waste not only takes up valuable landfill space, but it also adds to greenhouse gas emissions, disagreeable odors, and soil and groundwater pollution via leachate generation. Consequently, there is an increasing need for sustainable waste management approaches that can reduce waste accumulation while recovering valuable resources from organic waste (Hettiarachchi et al., 2018).

To solve these difficulties, governments, corporations, and scholars are increasingly turning to the circular economy as a viable alternative to the old linear economic model. Unlike the linear model, which employs a "take-make-dispose" strategy, the circular economy seeks to optimize resource efficiency by decreasing waste, extending product life cycles, and recovering valuable materials for future use. One of the basic ideas of the circular economy is resource recovery, which views trash as a valuable resource that can be turned into usable goods (Sukopovà & Vyrostkovà, 2025). In the context of organic waste, resource recovery methods convert nutrients and biomass into commercially viable outputs while minimizing environmental effect. This approach supports sustainable development by minimizing landfill dependency, conserving natural resources, and creating additional economic opportunities through waste valorization (Wang et al., 2025).

Indonesia's rapidly rising population and urban expansion pose considerable problems to organic waste management. Jakarta, one of Southeast Asia's major metropolitan areas, has particularly significant waste management difficulties. Every day, the city generates more than 7,000 tons of municipal solid garbage, which exceeds the capacity of current waste management facilities. The Bantargebang landfill in Bekasi, Jakarta's principal landfill, is anticipated to process 6,000 tons of garbage per day, with organic materials accounting for 50-60% of the incoming waste (Ali et al., 2023). As landfill capacity becomes more restricted, the ongoing dumping of organic waste leads to environmental deterioration, greenhouse gas emissions, and public health issues. Organic waste disposed of in landfills decomposes anaerobically, creating methane, a greenhouse gas with a far larger global warming potential than carbon dioxide, as well as leachate, which can contaminate nearby soil and water resources (Gosh et al., 2023). These environmental issues underscore the critical need for alternative waste management technologies that limit trash buildup while simultaneously recovering value from organic materials.

Among developing biological waste management solutions, Black Soldier Fly (Hermetia illucens) larvae (BSFL) have received a lot of interest because of their capacity to efficiently transform organic waste into useful products. BSFL are capable of eating significant amounts of biodegradable waste, such as food waste, agricultural leftovers, and market trash, in a relatively short time. This biological conversion process converts organic waste into two important products: nutrient-rich larval biomass and frass (Naser El Deen et al., 2023). This procedure drastically minimizes the quantity of organic waste that has to be disposed of in landfills while also recovering nutrients that would otherwise be wasted. As a result, BSFL technology is a successful example of resource recovery and waste valorization in the circular economy.

The goods produced by BSFL cultivation have significant economic worth. The larval biomass is abundant in protein and lipids, making it a suitable alternative element for aquaculture, poultry, and

cattle feed (Su et al., 2025). As worldwide demand for sustainable protein sources grows, BSFL-derived protein has gained popularity as an environmentally benign alternative to traditional feed ingredients like fishmeal and soybean meal. Furthermore, frass, the organic waste formed following larval digestion, includes critical nutrients that may be used as an organic fertilizer to boost soil fertility and reduce reliance on synthetic fertilizers (Martin et al., 2024). By generating valuable feed ingredients and organic fertilizers from low-value organic waste, BSFL technology illustrates how environmental sustainability and commercial value may be accomplished simultaneously. This dual contribution improves BSFL's involvement in circular economy programs by converting trash into commercial goods while lowering environmental constraints (Nugroho et al., 2023).

The use of BSFL technology has grown gradually in many parts of the world. Countries in Europe and North America are progressively incorporating BSFL into sustainable waste management and animal feed production systems, owing to advances in insect farming technology and rising demand for sustainable agricultural inputs (Siva Raman et al., 2022). Similar trends have been noticed throughout Asia, with nations such as Singapore, Malaysia, Thailand, Vietnam, and Indonesia investigating the use of BSFL to address organic waste management concerns while encouraging sustainable agriculture (Siddiqqui et al., 2024). In Indonesia, growing awareness of environmental sustainability and circular economy techniques has sparked increased interest in BSFL cultivation among researchers, businesses, rural communities, and local governments. Nonetheless, despite this increased interest, the adoption of BSFL-derived goods remains rather low, particularly among potential consumers who are unfamiliar with the technology and its benefits (Sumardiono et al., 2024).

Although multiple studies have shown that BSFL is technically effective in decreasing organic waste and providing useful byproducts, the successful usage of BSFL-derived goods is ultimately determined by potential customers' willingness to accept and embrace them. The introduction of new and ecologically friendly goods is frequently hampered by people's lack of information, perception of

possible hazards, or doubts about the safety, quality, and efficacy of unfamiliar items. As a result, understanding stakeholder perceptions has become more crucial in determining the elements that promote or impede the adoption of sustainable technology. Market acceptance is determined not just by a product's technical performance, but also by how consumers perceive its environmental advantages, economic worth, and related hazards. Therefore, examining these behavioural factors provides valuable insights into the likelihood of wider acceptance and utilization of BSFL-derived products (Salam et al., 2022).

Previous research has found that awareness, perceived environmental benefits, perceived economic advantages, and perceived hazards all play major roles in shaping people's adoption intentions for environmentally friendly products. Higher levels of awareness allow people to better comprehend the functions and benefits of new technology, while perceived environmental benefits reinforce the perception that using such items helps to environmental sustainability (Nyamurhirwa et al., 2025). Similarly, anticipated economic benefits such as possible cost savings, greater productivity, and new economic prospects also drive adoption decisions. In contrast, worries about product safety, quality, or ambiguity may hinder people's desire to accept new technology. These behavioral aspects have therefore become more crucial in determining commercial adoption of sustainable technologies such as BSFL-derived goods (Sheikh et al., 2023).

Despite the increasing body of literature on BSFL, previous research has primarily focused on biological efficiency, waste reduction performance, nutritional composition, and agricultural applications. Comparatively fewer studies have investigated stakeholder perceptions and adoption intentions towards BSFL-derived products, particularly within the Indonesian context. Furthermore, limited research has compared perceptions between industry-related stakeholders and the general public, despite these groups representing different levels of knowledge, experience, and potential adoption (Fujianti et al., 2025). Industry-related stakeholders may evaluate BSFL-derived products based on

their operational, environmental, and economic benefits, whereas the general public represents broader societal acceptance that may influence future demand and public support for sustainable waste management initiatives. Understanding the perspectives of both groups therefore provides a more comprehensive assessment of market perception and adoption (Ouko et al., 2022).

Given Jakarta's significant organic waste management challenges and increasing interest in sustainable resource recovery, understanding stakeholder perceptions towards BSFL-derived products is both timely and relevant. Identifying the factors that influence adoption can provide valuable insights for policymakers, researchers, and industry practitioners seeking to promote sustainable waste management practices and circular economy initiatives (Muhashiby et al., 2021). Therefore, this study aims to examine market perception and adoption of BSFL-derived products in Jakarta by evaluating stakeholder awareness, perceived environmental benefits, perceived economic benefits, perceived risks, and adoption intention using the Theory of Planned Behavior as the underlying theoretical framework.

## 1.2 Objective

The general objective of this study is to evaluate market acceptance and adoption potential of BSFL-derived products in Jakarta using a perception-based adoption framework based on Theory of Planned Behavior.

The specific objectives are:

- To assess stakeholder awareness and perception of BSFL-derived products in Jakarta.
- To examine the effects of awareness, perceived environmental benefits, perceived economic benefits, and risk perception on adoption intention.
- To compare perception differences between general public respondents and industry-related stakeholders.

- To develop business and managerial recommendations for improving market acceptance of BSFL-derived products.

### 1.3 Hypothesis

The study proposes the following hypotheses:

H1: Awareness has a positive effect on adoption intention toward BSFL-derived products.

H2: Perceived environmental benefits have a positive effect on adoption intention toward BSFL-derived products.

H3: Perceived economic benefits have a positive effect on adoption intention toward BSFL-derived products.

H4: Risk perception has a negative effect on adoption intention toward BSFL-derived products.

# Chapter 2

# Literature Review

### 2.1 Organic Waste Management and the Role of Black Soldier Fly Larvae in Resource Recovery

Municipal solid waste has become one of the most significant environmental challenges worldwide, particularly in rapidly urbanizing developing countries such as Indonesia. Population growth, urban