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# Insects as a sustainable protein alternative in pet food

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## Abstract

As the demand for sustainable solutions grows across various industries, the pet food sector has begun to explore alternative protein sources to reduce the environmental impact. Insects, such as black soldier fly larvae (BSFL), mealworms, and crickets, have been identified as promising options due to their high nutritional value and sustainable farming practices. This paper examines the environmental benefits of insect protein in the production of pet food, emphasizing reduced land use, water consumption, and greenhouse gas emissions compared to traditional livestock proteins. Through the lens of life-cycle assessments (LCAs), the resource efficiency and environmental impact of insect farming are quantified, highlighting its potential to actually transform the pet food industry. The study also discusses challenges, including consumer acceptance, scalability, and standardization of LCAs, offering insights into overcoming these barriers. By integrating insect protein into pet food, the industry can address global sustainability challenges while creating economic opportunities.

**Keywords:** Insect protein; Sustainable pet food; Environmental impact; Life-cycle assessment (LCA); Black soldier fly larvae (BSFL); Alternative protein sources; Circular economy; Pet food industry sustainability

## 1. Introduction

As the global pet food industry grows, so is environmental footprint. The production of traditional protein sources, such as beef, chicken, and fish, places a high and significant strain on the planet's natural resources. This challenge has sparked the interest in insect protein as a sustainable alternative. Insects, such as the black soldier fly larvae (BSFL), mealworms, and even crickets, are not only nutritionally rich but are also highly sustainable. This article examines the environmental benefits of insect farming, including reduced land use, water consumption, as well as greenhouse gas emissions, and explores life-cycle assessments (LCAs) to quantify their environmental impact.

## 2. Environmental Benefits of Insect Farming

### 2.1. Reduced Land Use

While traditional livestock farming have been providing sources of protein, it demands vast areas of land for grazing or cultivating feed crops. Insect farming, in contrast, requires minimal land due to its ability to thrive in vertical farming systems. These systems enable high-density production in compact spaces.

- **Comparison**: Producing 1 kilogram of beef protein requires approximately 200 square meters of land, whereas insect farming can produce equivalent protein on less than 15 square meters (Oonincx & de Boer, 2012).
- **Impact**: By decreasing the need for land, insect farming helps combat deforestation and biodiversity loss, which are key challenges associated with conventional agriculture.

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### 2.2. Lower Water Consumption

Water scarcity is becoming a growing concern especially in certain regions, with agriculture accounting for 70% of global freshwater use. Insect farming drastically reduces water usage compared to traditional livestock farming.

- **Water Efficiency**: Producing 1 kilogram of crickets requires just 1 liter of water compared to the 15,400 liters needed for 1 kilogram of beef (Van Huis et al., 2013).
- **Additional Advantage**: Many insects can derive hydration directly from their feed, further minimizing water requirements.

### 2.3. Reduced Greenhouse Gas Emissions

Livestock farming is a major contributor to greenhouse gas (GHG) emissions, including methane ($CH_4$) and nitrous oxide ($N_2O$), which are more potent than carbon dioxide ($CO_2$). Insect farming on the other hand produces negligible amounts of these gases.

- **Emission Comparisons**: The production of insect protein emits up to 100 times less greenhouse gases compared to cattle farming (Oonincx et al., 2010).
- **Waste Utilization**: Insects, especially BSFL, can be reared on organic waste, converting it into high-quality protein while reducing landfill emissions.

## 3. Life-Cycle Assessments (LCAs) of Insect Production

Life-cycle assessments provide a comprehensive evaluation of the environmental impact of a product or process, from production down to disposal. LCAs for insect farming highlight their resource efficiency and sustainability compared to conventional sources of protein.

### 3.1. Feed Conversion Efficiency

Insects are remarkably efficient at converting feed into body mass. For instance, BSFL can convert organic waste into protein with a feed conversion ratio (FCR) of 1.5, which is far superior to cattle with FCR of 6-10 and poultry with FCR of 2-3.

- **Nutritional Recycling**: BSFL can thrive on agricultural by-products and food waste, reducing the need for conventional feed crops

### 3.2. Carbon Footprint

The carbon footprint of insect protein is significantly lower than traditional livestock protein.

- **LCA Findings**: The production of 1 kilogram of edible cricket protein generates 2.7 kg of $CO_2$ equivalent emissions compared to 27 kg for beef and 7.3 kg for pork (Halloran et al., 2017).
- **Energy Use**: Although insect farming requires controlled environments (e.g., temperature regulation), technological advancements, such as renewable energy integration, are reducing energy demands.

### 3.3. Waste Management and Circular Economy

Insects, particularly BSFL, play a critical role in waste management by converting organic waste into valuable by-products such as frass, which can be used as fertilizer.

- **Circular Economy**: By integrating insect farming with waste recycling systems, a circular economy can be achieved, enhancing both environmental and economic sustainability (Parodi et al., 2018).

## 4. Challenges and Future Prospects

### 4.1. Standardization of LCAs

While LCAs demonstrate the environmental benefits of insect farming, differences and variations in methodologies, feed sources, as well as farming practices can lead to inconsistent results. Standardizing LCA methodologies will provide more reliable data.

### 4.2. Scaling Production

To compete with traditional protein sources, the insect farming industry would need to overcome challenges such as scaling production, ensuring regulatory compliance, and addressing consumer acceptance. Several investments in automation and biotechnology can help address these barriers.

### 4.3. Consumer Acceptance

The potential irritating or "yuck factor" remains a challenge for insect-based products, particularly in Western markets. However, in pet food, this barrier is minimized as the consumer, that is the pet owner, would not be directly consuming the product.

## 5. Conclusion

Insect protein offers a sustainable and efficient alternative to traditional livestock proteins in the pet food industry. Its minimal land and water requirements, low greenhouse gas emissions, and potential for waste recycling position it as a transformative solution to address the environmental challenges of protein production. Life-cycle assessments further underscore the ecological advantages of insect farming, although standardization and scalability remain key areas for development.

As a DVM holder and MBA candidate, I clearly see the dual potential of insect-based pet food to address global sustainability challenges and to drive economic opportunities in the rapidly growing pet food market. By bridging the gap between science and strategy, the adoption of insect protein can contribute to a more sustainable future for the pet food industry.

## Compliance with ethical standards

*Disclosure of conflict of interest*

No conflict of interest to be disclosed.

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