

Insects as a Source of Food and Feed

Lipsa Dash*

*Assistant Professor, College of Horticulture,
Odisha University of Agriculture and Technology, Odisha*

Corresponding Author

Lipsa Dash

Email: lipsa.bckv@gmail.com



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ABSTRACT

Insects are increasingly recognized as a promising source of nutrition for humans and animals. Not only do they offer high-quality protein, essential amino acids, unsaturated fats, vitamins and minerals, but they can also be reared with far lower environmental footprint than conventional livestock. Many insect species (e.g. black soldier fly, crickets, mealworms) are being studied and used both for human food (entomophagy) and as feed ingredients for livestock, fish, poultry and pets. Key drivers include rising global protein demand, food waste, land use constraints, and climate change. However, challenges remain: consumer acceptance, regulations, food safety, cost of production, and scaling up insect farming. With supportive policy, improved processing, and continued research, insects could be an important component of sustainable food systems.

INTRODUCTION

When most people think of food, insects are rarely the first image that comes to mind. For many, the idea of eating crickets, beetles, or mealworms might even trigger a sense of discomfort. Yet, across the world, over 2 billion people already consume insects as part of their traditional diets. Insects, whether eaten directly as food or used indirectly as feed for livestock and

aquaculture, are gaining attention as a sustainable solution to global food security challenges.

As the global population races toward 10 billion by 2050, the demand for protein is expected to double (Van Huis, 2024). Traditional livestock production already places immense pressure on land, water, and the environment. Climate change, dwindling

natural resources, and ecological imbalances have made it clear that we need alternative, eco-friendly protein sources. Insects, with their high nutritional value, low environmental footprint, and cultural acceptance in many parts of the world, offer a promising pathway to sustainable food systems.

Historical and Cultural Background

Insect consumption, known as entomophagy, is not new. Indigenous communities in Asia, Africa, and Latin America have eaten insects for centuries. For instance:

Mexico is famous for chapulines (toasted grasshoppers) served with lime and chili.

In Thailand, fried bamboo worms and crickets are popular street food.

In parts of Africa, caterpillars and termites are delicacies rich in protein.

Native tribes in Australia have long relied on witchetty grubs as a traditional source of nutrition.

Insects have not only been valued for their taste but also for their cultural symbolism and medicinal uses. However, Western societies largely avoided insect consumption due to cultural barriers and abundant livestock resources. Now, with global pressures mounting, even Europe and North America are revisiting entomophagy.

Nutritional Value of Edible Insect

Insects are miniature nutritional powerhouses (Van Huis, 2015). Their composition varies among species, but most edible insects are rich in:

- **Protein:** Ranges from 35–70% of dry matter, often comparable or superior to beef and chicken.

- **Essential amino acids:** Balanced profiles that support human health.
- **Healthy fats:** Including polyunsaturated fatty acids (PUFAs) and omega-3s.
- **Micronutrients:** Rich in iron, zinc, calcium, magnesium, and B vitamins.
- **Fiber:** In the form of chitin, which may support gut health.

For example, crickets contain about 60% protein by dry weight, while mealworms offer protein and omega-3 fatty acids similar to fish. For malnourished populations, insects can bridge the nutritional gap, especially where meat and fish are scarce or unaffordable.

Environmental Benefits

One of the strongest arguments for insect-based food and feed lies in sustainability. Compared to cattle, poultry, and pigs, insects require far fewer resources.

1. Feed Conversion Efficiency

Insects are cold-blooded and convert feed into body mass more efficiently. Crickets, for example, need 6 times less feed than cattle to produce the same amount of protein.

2. Water and Land Use

Livestock farming consumes about 70% of agricultural land. Insects can be reared in vertical farms with minimal land. They also require drastically less water, a critical advantage in drought-prone areas.

3. Greenhouse Gas Emissions

Cattle produce large amounts of methane, a potent greenhouse gas. Insects release negligible emissions, making them climate-friendly protein alternatives.

4. Circular Economy Role

Many insect farms use agricultural by-products or food waste as feed. This not only reduces waste but also recycles nutrients back into the food chain.

Insects as Animal Feed

While insects are gaining popularity as direct human food, their use as animal feed may prove even more transformative. Fishmeal and soybean meal, the backbone of poultry and aquaculture industries, face rising costs and environmental concerns. Insects can step in as an alternative protein source.

- Poultry: Chickens fed on black soldier fly larvae grow faster and remain healthy.
- Aquaculture: Fish such as tilapia and salmon thrive on insect-based diets.
- Pets: Pet food companies are increasingly using cricket protein and insect flour.

Replacing conventional feeds with insect protein can reduce dependence on imported soy and overfished marine resources, making global food chains more sustainable.

Global Trends and Market Growth

The edible insect market is expanding rapidly. By 2030, it is projected to be worth over USD 6 billion. Startups and food companies are experimenting with insect-based snacks, protein bars, pasta, and flour. For instance:

- Europe: Regulatory approvals are allowing companies to sell cricket powder and mealworm products.
- United States: Cricket protein bars and chips are gaining popularity among fitness enthusiasts.
- Asia: Countries like Thailand and China are investing in large-scale insect farms.

Governments, too, are supporting insect farming as part of sustainable food strategies. The UN's Food and Agriculture Organization (FAO) has strongly endorsed insects as food and feed.

Barriers and Challenges

Despite the advantages, several challenges hinder widespread adoption:

1. Cultural Acceptance: In many societies, insects are associated with dirt and pests. Changing mindsets will require education, marketing, and culinary innovation.
2. Regulation: Insect farming is still new, and many countries lack clear legal frameworks for food safety and trade.
3. Scaling Up Production: Maintaining hygiene, cost-effectiveness, and consistent quality in mass production requires technological advances.
4. Allergies and Safety: Some insects may trigger allergic reactions, particularly in people allergic to shellfish. Ensuring safety standards is crucial.

Success Stories and Innovations

Creative approaches are helping insects enter mainstream diets:

- Insect flour: Neutral in taste, easy to mix into baked goods or pasta.
- Protein powders: Marketed to athletes for high performance.
- Gourmet dishes: Top chefs are introducing insects into fine dining menus.
- Startups: Companies like Entomo Farms (Canada) and Ÿnsect (France) are pioneering industrial-scale insect production.

These innovations are not only normalizing insect consumption but also showing that sustainable choices can be tasty and trendy.

Ethical and Social Perspectives

Compared to conventional livestock, insect farming raises fewer ethical concerns. Insects are abundant in nature, reproduce quickly, and can be harvested with minimal stress. Moreover, insect farming can empower rural communities by providing new income sources. Smallholder farmers can raise insects with little investment, creating local jobs and boosting food security.

Future Prospects

The potential of insects in global food and feed systems is immense. If integrated into mainstream diets and supply chains, they could:

- Reduce pressure on traditional livestock systems.
- Support global nutrition goals.
- Help fight hunger and malnutrition in developing countries.
- Mitigate climate change by lowering emissions and resource use.

In the near future, insect-based products are likely to become as normal as soy protein or tofu are today. With growing awareness, regulatory support, and culinary creativity, insects may soon move from novelty snacks to household staples.

CONCLUSION

Insects, long ignored in the Western food system, are now emerging as a solution to some of the biggest challenges of our time: feeding a growing population, reducing environmental damage, and ensuring nutrition security. From crickets in protein bars to black soldier fly larvae in fish farms, insects are no longer just a curiosity—they are a necessity.

If humanity is serious about building a sustainable food future, embracing insects as food and feed will be an important step. After all, what seems unusual today may be tomorrow's normal. And when it comes to saving the planet, even the smallest creatures can play the biggest role.

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