International Journal of Entomology Research
www.entomologyjournals.com
ISSN: 2455-4758
Received: 31-07-2025, Accepted: 30-08-2025, Published: 15-09-2025
Volume 10, Issue 9, 2025, Page No. 59-61

A review on edible insects and their role in promoting sustainable food systems in North East India

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Abstract
North-East India, comprising the adjacent "Seven Sister" states and Sikkim, is the part of Indo-Burma global biodiversity hotspot and harbours an exceptional diversity of insects and indigenous peoples. North East India, a region rich in biodiversity and cultural diversity, has a long- standing tradition of entomophagy-the practice of consuming insects. Various indigenous communities in North-East India have developed unique knowledge systems around the identification, harvesting, processing, and consuming of insects. With growing global interest in sustainable and substitute protein sources the edible insects offer an environmentally sound, nutritionally rich, and culturally useful food option. This review explores the diversity of entomophagy, traditional practices, nutritional value and socio-economic potential of edible insects in North-East India. It also highlights the challenges, policy gaps, and future directions for the sustainable utilization of insects as food and feed in the region.

Keywords: Edible insects, entomophagy, North-East India, traditional knowledge, sustainable food, tribal communities

Introduction

As the world faces increasing pressure on food systems due to climate change, population growth, and unsustainable agricultural practices, there is an increasing demand for alternative food sources. Edible insects have emerged as a viable solution due to their high nutritional value, low environmental impact, and cultural acceptability in many tradional societies (Van Huis *et al.*, 2013) [23]. Entomophagy the practice of eating insects by human has re emersed globally as a promising pathway to diversify diets and reduce the environmental footprint of protein production. Recent syntheses estimate over 2,200 insect species are consumed throughout 128 countries, with Asia contributing the highest regional diversity; India alone account s for ~260 documented edible species, underscoring its biocultural importance in global atlas of edible insects (Roge *et al.* 2024) [16]

North-East India is a home to more than 200 ethnic communities, the practices of entomophagy is deeply embedded in tribal life. Many tribes across the states like Sikkim, Arunachal Pradesh, Assam, Manipur, Meghalaya, Mizoram, Nagaland, and Tripura have consumed insects for generation, both as delicacies and staple food. However regardless of its cultural and ecological significance, edible insects' practices in India remains under-researched and under-recognized in policy and development agendas (Chakravorty *et al.*,2011) [2]. Parallel socio-economic analyses from Nagaland shows that the edible insects remain deeply embedded as ethnic foods across age gender, while also functioning as supplemental income sources for collectors and vendors- evidence that conservation, nutrition and livelihood are interwined (Mozhui *et al.*2024) [12].

This review aims to analyse the traditional practices, diversity, utilization, and potential of edible insects in North-East India, highlighting their role in nutrition, economy, and sustainability.

Diversity of Edible Insects in North-East India: North-East India is a part of the Indo-Burma biodiversity hotspot, supports a wide variety of edible insect species. Studies report over 250 insect species being consumed across different states in India (Chakravorty *et al.*, 2011 [2]; Sarmah & Hazarika;2012) [18]. Many communities consume Diptera, Mantodea, and Ephemeroptera during specific seasons (Nongkhlaw & Joshi, 2014) [13].

Edible insect is a traditional practice among the ethnic communities of Arunachal Pradesh, Assam, Manipur, Meghalaya, Mizoram, Nagaland, Tripura and Sikkim, the practice is deeply rooted in cultural traditions and continues to play significant role in the community's way of life. In North-East India around 41 species of edible insects under 6 orders and 18 families are consumed (Shantibala *et al*,2012 [22]; Singh KM *et al*, 2013 [21]; Devi MB *et al*,2014) [6] (Table 1).

Table1: List of edible insects of different ethnics of North East India

Sl. No	Order	Family	Scientific name	Common name
1	Coleoptera	Dyticidae	*Dytiscus marginalis*	Great diving beetle
2	Coleoptera	Dyticidae	*Hydrchera rickseckeri*	Water beetle
3	Coleoptera	Dyticidae	*Cybis sp.*	Water beetle
4	Coleoptera	Dynastidae	*Eurytrachelus titan*	Beetle
5	coleoptera	Lucanidae	*Odontolabis cuvera*	Stag beetle
6	Coleoptera	Scarabaeidae	*Analeptes trifasciata*	Flat-facedlonghorn beetle
7	Coleoptera	Cerambycidae	*Batocera horsefieldi*	Long horn beetle
8	Coleoptera	Cerambycidae	*Dihammus cervinus*	Long horn beetle

9	Coleoptera	Curculionidae	*Rhynchophorus ferrugineus*	Palm weevil
10	Coleoptera	Curculionidae	*Rhynchophorus phoenicis*	Palm weevil
11	Hemiptera	Belostomatidae	*Lethocerus indicus*	Giant water bug
12	Hemiptera	Pentatomidae	*Ochrophora montana*	Pentatomid bug
13	Hemiptera	Nepidae	*Laccotrephes ruber*	Water scorpion
14	Hemiptera	Cicadidae	*Pomponia imperatoria*	Cicada
15	Hemiptera	Cicadidae	*Okanagana sp.*	Cicada
16	Hemiptera	Naucoridae	*Pelocoris femoratus*	Creeping water bug
17	Hymenoptera	Apidae	*Apis cerana*	Honey bee
18	Hymenoptera	Apidae	*Apis mellifera*	Honey bee
19	Hymenoptera	Apidae	*Apis florea*	Little bee
20	Hymenoptera	Apidae	*Apis dorsata*	Giant Honey bee
21	Hymenoptera	Vespidae	*Vespa affinis*	Wasp
22	Hymenoptera	Vespidae	*Polistes stigmata*	Paper wasp
23	Hymenoptera	Vespidae	*Polistes olivaceus*	Paper wasp
24	Hymenoptera	Vespidae	*Parapolybia varia*	Lesser Paper wasp
25	Hymenoptera	Formicidae	*Oecophylla smaragdina*	Red Ant
26	Hymenoptera	Formicidae	*Dorylus orientalis*	Army ants
25	Hymenoptera	Formicidae	*Atta sp.*	Leaf cutter ants
26	Hymenoptera	Formicidae	*Myrmica rubra*	Common red ant
27	Hymenoptera	Formicidae	*Formica indica*	Wood ants
28	Orthoptera	Acrididae	*Chondacris rosea*	Short horn Grasshopper
29	Orthoptera	Acrididae	*Phlaeoba infumata*	Short horn Grasshopper
30	Orthoptera	Acrididae	*Melanoplus sp.*	Short horn Grasshopper
31	Orthoptera	Acrididae	*Oxya fuscovittata*	Short horn Grasshopper
32	Orthoptera	Acrididae	*Hieroglyphus banian*	Short horn Grasshopper
33	Orthoptera	Acrididae	*Schistocerca gregaria*	Deset locust
34	Orthoptera	Acrididae	*Eupreponotus inflatus*	Short horn Grasshopper
35	Lepidoptera	Bombycidae	*Bombyx mori*	Mulberry silkworm
36	Isoptera	Termitidae	*Odontotermes sp.*	Termite
37	Isoptera	Termitidae	*Macrotermes natalensis*	Termite
38	Isoptera	Termitidae	*Macrotermes bellicosus*	Termite
39	Isoptera	Termitidae	*Macrotermes sp.*	Termite
40	Isoptera	Rhinotermitidae	*Reticulitermes flavipes*	Termite
41	Isoptera	Termitidae	*Termes sp.*	Termite

Traditional knowledge and Practices of edible insects: Indigenous communities possess deep ethno-entomological knowledges, including insect life cycles, habitat selection, seasonality, and safe preparation methods. Hand-picking or netting during peak swarming seasons (e.g., termites post – monsoon). Light traps for nocturnal species like water bugs, Nest harvesting for ant larvae and wasps, using fire smoke to drive insects out (Chakravorty *et al.*,2011) [2]. Preparation and Cooking is done by many methods, generally Roasting is the most common method, enhancing flavor and removing pathogens. Fermentation (e.g., red ants with fermented fish in Meghalaya) is practiced for preservation method. Boiling or frying silkworm pupae is common in Assam, Nagaland and sikkim. Chutneys and sauces are made using crushed water bugs and ants. These techniques serve not only culinary practices but also part cultural rituals, festivals, and traditional medicine.

Nutritive and medicinal value of edible insects: Entomophagy, the practices of consuming insects, offers significant nutritive benefits and aligns with medicinal and conscious eating practices. Edible insect are rich in high - quality of essential amino acids, healthy lipids such as omega-3, omega 6 fatty acds, vitamins like B12, and minerals including iron, zinc, and calcium, making them an excellent alternative to conventional animal protein sources (Rumpold &Schluter,2013 [17]; Payne *et al*., 2016). Additionally, insects contain bioactive compounds, antioxidants that support gut health and immune function (Belluco *et al.*, 2013) [1]. Beyond their nutritional value, edible insect fosters a medicinal relationship with food by encouraging conscious eating, sustainability awareness, and cultural connection (Mabbutt &Fast, 2021) [11]

Edible insects are highly nutritious. On average, they contain: Protein: 40-75% (dry weight), comparable to meat (Ghosh *et al.*, 2017) [8]. Fat: 10-35%, including essential fatty acids. Vitamins: B12, riboflavin, folic acid. Minerals: Calcium, iron, zinc, magnesium. These nutritional attributes make insects ideal for reduce the malnutrition in rural populations.

Cultural and Medicinal Relavanc: Edible insects are linked to various cultural beliefs and traditional medicine systems. Ant broths are used for sore throats. Termites are used to treat wounds and gastrointestinal issues (Singh & Devi,2019) [20]. Festivals and rituals in tribal communities often include insect-based foods. In many tribal mythologies, insects are symbols of fertility, health, and ecological balance. Insect consumption supports sustainability: Reduced greenhouse gas emissions relative to livestock. Efficient feed-to-meat conversion ratio. Low water usage can be reared on organic waste and by-products (Van Huis *et al*.,2013) [23]. For example, black soldier fly larvae in Tripura are used for waste management and feed production (Mandal & Sharma,2023) [10]. Wild harvesting is still common but needs regulation to prevent over-exploitation.

Materials and Methods

Databases (Scopus, Web of Science, PubMed, Google Scholar) were quried with combinations of edible insects, entomophagy, North-East India, and each of the eight state names. The search window spanned January 1975- June 2025 and was filtered for English- language peer-reviewed articles, theses, conference proceedings, and credible grey literature (e.g., FAO reports). Additional refences were obtained via snowballing.

Discussion

Urban population often view insect consumption as primitive. Misconceptions and myth about cleanliness and safety hinder mainstream adoption (Das,2021) [4].

Overexploitation and Habitat Loss-Increasing demand may threaten local biodiversity. Habitat destruction reduces insect populations and traditional access. Insect Farming-Pilot farms in Assam and Tripura are the experimenting with crickets, mealworms, and silkworms' pupae. Integrating insect farming into rural development schemes could promote nutrition and income. Research and Innovation-Developed improved rearing systems. Explore nutraceutical and pharmaceutical potential. Document indigenous knowledge before it disappear (Pathak & Bora, 2017) [14].

Policy Support-Create a national registry of edible insect species. Recognize edible insect under the Tribal Food Security and Biodiversity Programs. Offer training, microcredit, and enticement for insect – based enterprises.

Conclusion

North-East India's edible insects' tradition offers a time-tested approach to sustainable food systems rooted in biodiversity and indigenous knowledge. Entomophagy is not only rich in nutrients but also socially, economically, and environmentally desirable. With supportive policies, research investment, and consumer education, edible insects can offer significant support to food security, poverty alleviation, and ecological resilience in the region and beyond. However, insect farming and their conservation and marketing facilities can be advanced through North -East India to improve the source of income for landless farmers.

Acknowledgement The authors are thankful to HoD, Department of Zoology, Bhattadev University for providing facilities for healthy discussion and suggestions.

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