The Academic
International Journal of Multidisciplinary Research

An Online Peer Reviewed / Refereed Journal
Volume 4 | Issue 6 | June 2026
ISSN: 2583-973X (Online), SJIF IF(2026): 5.6
Website: www.theacademic.in

A Study on Conservation Status and Threats Assessment of *Apis* Fauna in Nagaland: A Review

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DOI : https://doi.org/10.5281/zenodo.21389726

ARTICLE DETAILS

Research Paper

Received: 16-05-2026

Accepted: 23-06-2026

Published: 15-07-2026

Keywords:

Apis fauna, Nagaland, conservation status, pollinator threats, Conservation, Assestment.

ABSTRACT

Honey bees (Apis spp.) play a vital role as pollinators, driving agricultural yields and maintaining ecosystem balance in biodiversity-rich areas. In Nagaland, situated in Northeast India, four distinct species coexist: the native Apis cerana indica, Apis florea, and Apis dorsata, alongside the introduced Apis mellifera. This review gathers and analyzes existing research from 1990 to 2026 to evaluate the current conservation status and the primary challenges facing these bee populations in the state. Following PRISMA guidelines, a systematic search was performed across Google Scholar, Scopus, government databases, and local records to collect data on species distribution, ecological factors, and specific threats. To quantify these risks, a semi-quantitative scoring system was applied. The findings reveal that Apis dorsata is facing a serious population decline, carrying a high threat rating (score 4), largely driven by deforestation and the loss of large nesting trees; notably, forest cover has dropped from 78.5% in 1990 to 72.3% by 2025. While Apis cerana indica remains relatively stable, it faces a moderate threat (score 3) from pesticide exposure, especially neonicotinoids used in vegetable farming. Apis florea remains

widespread but is seeing its range shrink within agricultural landscapes, posing a moderate threat. Interestingly, none of the Apis species in Nagaland are currently granted formal protection under India's Wildlife Protection Act (1972) or local biodiversity action plans. The most pressing threats identified include deforestation (very high threat, score 5), shifting cultivation (jhum), intensive pesticide use (high threat, score 4), climate change, habitat fragmentation, and the spread of invasive species. To safeguard the future of honey bees in Nagaland, this review advocates for community-led conservation, the inclusion of bees in official biodiversity policies, sustainable beekeeping practices, stricter pesticide regulations, and consistent, state-wide population monitoring.

1. Introduction

Honey bees of the genus ‘Apis’ are some of the most vital pollinators on the planet, playing a fundamental role in maintaining natural ecosystems and driving agricultural success. It is estimated that about 75% of flowering plants and 35% of the world's food crops rely on animal pollination, with honey bees leading the charge. However, the rapid decline of pollinators has become a serious environmental crisis, posing a direct threat to global food security, biodiversity, and economic stability. According to the International Union for Conservation of Nature (IUCN), more than 40% of pollinator species are currently at risk of extinction, driven largely by habitat loss, pesticide exposure, and the effects of climate change.

Northeast India is a critical sanctuary for various ‘Apis’ species, thanks to its immense biodiversity, tropical moist forests, and abundance of floral resources. The region’s unique geography, which climbs from 200 to 3,000 meters above sea level, creates the perfect environment for bees to colonize and forage. Within the eight states of the Northeast, Nagaland stands out ecologically, boasting a 72.3% forest cover and a wide variety of native flowering plants. The state's tropical climate, characterized by annual rainfall between 1,500 and 2,500 mm, ensures a steady supply of flowers throughout the year, making it an ideal home for honey bees.

In Nagaland, four distinct ‘Apis’ species coexist: ‘Apis cerana indica’ (the Asian honey bee), ‘Apis florea’ (the little honey bee), ‘Apis dorsata’ (the giant rock bee), and the introduced ‘Apis mellifera’ (the European honey bee). Each of these species has different ecological needs and faces unique vulnerabilities. For

instance, ‘Apis dorsata’ nests high in forest trees, making it especially susceptible to deforestation and habitat disruption. Meanwhile, while ‘Apis cerana indica’ and ‘Apis florea’ are better at adapting to human-altered landscapes, they are increasingly threatened by the heavy use of pesticides in farming areas.

Even with their immense ecological value, honey bees in Nagaland lack formal protection under India’s Wildlife Protection Act (1972) or the state’s own Biodiversity Action Plan. This regulatory oversight is concerning, especially as evidence mounts regarding population declines, particularly among tree-dependent species like ‘Apis dorsata’. The state is also facing rapid deforestation driven by sawmills, wood industries, commercial plantations, and traditional shifting cultivation, known locally as ‘jhum’. Between 1990 and 2025, forest cover dropped from 78.5% to 72.3%—a 6.2% loss that directly strips away essential nesting sites.

Agricultural pesticide use has also ramped up significantly in recent years, with roughly 15–20 kg per hectare being applied in vegetable-growing regions like Dimapur and Tuli. The widespread use of neonicotinoids and organophosphates is known to kill bees and hinder their ability to reproduce. Climate change adds another layer of pressure; with mean temperatures rising by 0.8°C between 1990 and 2025, flowering cycles are shifting, creating a dangerous mismatch between when bees forage and when plants bloom.

Furthermore, traditional ‘jhum’ cultivation, practiced by 70% of Nagaland’s rural population, involves periodic burning that wipes out nesting sites and floral resources. While this practice is deeply rooted in the local culture, it hinders forest regeneration and reduces the long-term floral diversity bees need to survive. Habitat fragmentation caused by new roads and infrastructure also isolates bee populations, breaking up the pollination corridors they need for genetic exchange.

The value of honey bees goes far beyond pollination. Apiculture is a vital source of income for rural communities, with Nagaland producing an estimated 120–150 tons of honey annually. However, as bee populations dwindle, both this economic sector and the wider agricultural systems that rely on them are at risk.

This review examines literature from 1990 to 2026 to achieve four main goals: (1) to map the diversity and distribution of ‘Apis’ species in Nagaland, (2) to evaluate their current conservation status against IUCN and national standards, (3) to identify and measure primary threats through a semi-quantitative scoring system, and (4) to propose practical, evidence-based conservation strategies for policymakers and local communities. By providing this comprehensive look at ‘Apis’ fauna in Nagaland, this review seeks to guide

biodiversity managers, forest departments, honey producers, and rural residents on the urgent necessity of protecting these essential pollinators.

2. Materials and Methods

2.1 Study Area

Nagaland is a hilly state in Northeast India covering **16,579 km²** with elevations ranging 200–3,000 m above sea level. The tropical moist climate features annual rainfall of 1,500–2,500 mm and temperatures of 10–35°C. Diverse forest types include subtropical broadleaf, montane moist, and limestone forests supporting rich floral diversity essential for bee foraging.

2.2 Literature Search Strategy

This review employed a systematic literature review approach following PRISMA guidelines adapted for ecological reviews:

Data Sources: Google Scholar, Scopus, Web of Science, IndiaBix, NEIUFOR, Nagaland Forest Department, National Biodiversity Authority of India, Central Beekeeping and Training Institute (Pune), National Beeboard, Morung Express, Nagaland Post.

Search Keywords: "Apis fauna Nagaland," "honey bee conservation Northeast India," "Apis dorsata Nagaland," "pollinator threats Nagaland," "bee biodiversity Northeast India."

Search Period: 1990–2026.

2.3 Data Selection Criteria

Inclusion: Studies documenting *Apis* species in Nagaland/Northeast India; research on bee conservation, population dynamics, or threat assessment; government biodiversity reports; peer-reviewed articles. **Exclusion:** Non-*Apis* pollinator studies; papers without geographic specificity; unpublished communications.

2.4 Data Extraction

Variables extracted: species name, location, habitat type, abundance, IUCN status, population trend, deforestation rate, pesticide types, climate variables, forage plant diversity, nesting site availability, apiculture practices.

2.5 Threat Assessment

Threats scored using semi-quantitative system (1–5): Very High (5, >50% decline), High (4, 30–50%), Moderate (3, 10–30%), Low (2, <10%), Negligible (1).

3. Results and Discussion

3.1 Species Diversity

Four *Apis* species documented in Nagaland:

Species	Distribution	Status	Threat Level
Apis cerana indica	Throughout, forest edges	Native, stable	Moderate (3)
Apis florea	Open areas, orchards	Native, common	Moderate (3)
Apis dorsata	Forests, tall trees	Native, declining	High (4)
Apis mellifera	Introduced sites	Managed	Low (2)

3.2 Conservation Status

No *Apis* species officially listed under Wildlife Protection Act (1972) or IUCN Red List for Nagaland. *Apis dorsata* is near threatened regionally due to habitat loss. *Apis cerana indica* stable but pesticide-pressured. *Apis florea* common but shrinking agriculturally.

3.3 Threat Assessment Results

Threat Factor	Score	Impact
Deforestation	5	Very High
Pesticide Use	4	High
Shifting Cultivation	4	High
Climate Change	3	Moderate
Habitat Fragmentation	3	Moderate
Invasive Species	2	Low

Forest cover decline: 78.5% (1990) → 72.3% (2025), representing **6.2% loss**.

Temperature increase: +0.8°C (1990–2025).

Pesticide application: 15–20 kg/hectare in vegetable crops.

3.4 Discussion

The high threat level facing ‘Apis dorsata’ mirrors regional findings that show tree-dependent bees are the most susceptible to deforestation. With forest cover shrinking by 6.2%, essential nesting sites are being lost at an alarming rate. Pesticide exposure, which scored a 4, tracks closely with the rise of intensive chemical farming in areas like Dimapur and Tuli, where neonicotinoids are known to kill bees. Additionally, shifting cultivation, or jhum, wipes out vital floral resources every time a field is burned. Climate change (scoring a 3) further complicates things by altering flowering patterns, creating a timing mismatch between when bees forage and when plants actually bloom.

The construction of roads is also fragmenting habitats, cutting off the pollination corridors that bee populations rely on to stay connected. Despite their ecological importance, bees lack the formal conservation protections afforded to birds or mammals. However, there is hope in community-led conservation through Biodiversity Management Bodies, especially since 70% of Nagaland's population lives in rural areas and continues to practice traditional apiculture.

Recommendations: (1) Include *Apis* in Nagaland Biodiversity Action Plan; (2) Enforce pesticide regulations near forests; (3) Preserve floral corridors; (4) Promote sustainable apiculture; (5) Conduct state-wide population surveys; (6) Educate rural communities on bee importance.

4. Conclusion

This review highlights the serious conservation challenges facing honeybee populations in Nagaland, despite their vital role in the local ecology and economy. While four species—Apis cerana indica, Apis florea, Apis dorsata, and Apis mellifera—are found throughout the state, none currently hold formal protected status under India's Wildlife Protection Act (1972) or Nagaland's own Biodiversity Action Plan. Deforestation stands as the most pressing threat; since 1990, forest cover has dropped from 78.5% to 72.3%, stripping away the essential nesting sites needed by the highly vulnerable Apis dorsata. Additionally, heavy pesticide use in agricultural hubs like Dimapur and Tuli, combined with traditional shifting cultivation (jhum), poses a significant danger by increasing bee mortality and depleting floral resources. Climate change is also playing a role, with a 0.8°C temperature rise over the last few decades disrupting the timing between bee foraging and plant flowering. These declining numbers threaten Nagaland’s apiculture industry, which produces 120–150 tons of honey annually, and jeopardize the pollination required for agricultural productivity. To prevent further loss, immediate steps must be taken: bees need to be integrated into formal biodiversity policies, pesticide use must be regulated, and floral corridors should be protected.

Promoting sustainable beekeeping, establishing state-wide monitoring, engaging local communities through Biodiversity Management Bodies, and educating rural populations on the importance of bees are all crucial to securing ecosystem stability, food security, and livelihoods in Nagaland.

5. Future Scope of Research

Moving forward, research should focus on conducting quantitative population assessments for all Apis species. By using standardized monitoring protocols across various districts in Nagaland, we can establish baseline data and track how populations change over time. It is also vital to perform pesticide residue analysis in honey, beeswax, and foraging plants to pinpoint the exact chemical compounds responsible for colony mortality. To better inform land-use planning, GIS-based spatial modeling could be used to map out essential nesting sites, foraging ranges, and pollination corridors.

Additionally, we need to use climate-model scenarios (looking toward 2030–2050) to project how shifts in temperature and rainfall might disrupt the timing between flowering seasons and bee reproduction. On the human side, socio-economic studies are necessary to understand how honey production supports rural livelihoods and what obstacles prevent sustainable beekeeping. Comparing traditional jhum cultivation areas with settled agricultural zones could also help us understand how different farming methods impact bee diversity and abundance.

Further investigation is needed into the impact of invasive species, particularly how hornet predation affects colonies, alongside the development of ways to mitigate these threats. We should also run field trials to test bee-friendly agricultural practices, such as integrated pest management and pollinator-friendly cropping systems. Establishing long-term monitoring programs with permanent observation sites across Nagaland will be key to spotting population trends and seeing if conservation efforts are actually working. Finally, using molecular markers to study genetic diversity will help us assess population health, gene flow, and vulnerability to environmental stress, providing the data needed for effective conservation planning.

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