Education

Reviving traditional agricultural systems through pollinating insects

Pollobi Duara
Department of Zoology, Majuli College, Assam, India
*Corresponding author: Pollobi Duara
Received 09 March 2026; Accepted 2 May 2026; Published 14 May 2026
DOI: https://doi.org/10.64171/JAES.6.3.45-46

Abstract
Traditional agricultural systems rely heavily on ecological processes such as pollination, but not much study have been done in this field. The traditional agriculture system and the farmers associated with them lack knowledge about the role of pollinating insects in agriculture. This study aims to study the pollinating insect diversity and their role in traditional agroecosystems. Methods used were Field surveys, floral resource assessments, pollinator visitation studies and interviewing with the farmers. The study highlights the importance of community-based ecological management for sustainable agriculture. This study investigates the relationship between pollinating insects and traditional agroecosystems. Traditional systems with mixed crops and native flowering plants harbours higher pollinating insects compared to monocultures. Visitation rates were high in natural habitat where less chemicals were applied. Declines in pollinator activity was recorded in areas with more chemical use or limited flower diversity. Protecting pollinating insects not only benefits crop yields but also supports biodiversity. Pollination maintains crop diversity and also ensure food safety and security.

Keywords: Pollinating insects, Traditional agriculture, Diversity, Visitation rate, Food safety

Introduction

Traditional agricultural systems have historically sustained rural communities by relying on ecological balance, biodiversity, and low-input farming. Agricultural land accounts for approximately 50% of the terrestrial land surface (Kearns *et al*. 1998) [4], providing humans with food and medicinal plants. Pollinating insects play a crucial role in these systems by enabling reproduction in a wide range of crops and wild plants. Insect pollination enhances yield and/or quality in 75% of the world's leading crops, accounting for an estimated 35% of food production (Klein *et al*., 2007) [5]. However, pollinator populations are under threat globally due to factors such as pesticide exposure, habitat fragmentation, invasive species, and climatic fluctuations. Reviving traditional systems therefore requires prioritizing pollinator conservation. This study investigates the relationship between pollinating insects and traditional agroecosystems, assessing their role in enhancing crop productivity and ecological sustainability. The altered biotic and abiotic conditions in the urban microclimate compared to the surrounding non-urbanised area (Williams *et al*., 2015) [7], together with the deliberate introduction of new species (Williams *et al*., 2009) [8], forest loss and soil sealing derived from urban sprawl (Ferreira *et al*., 2020) [2], result in a decrease in plant resources altering biotic interactions, such as the pollination process.

Methodology

Study area

The study was conducted in traditional farming landscapes in Majuli district of Assam, where crop diversity and mixed land use remain prevalent. Majuli, the world's largest inhabited river island, is situated in the Brahmaputra River in Assam, India. It spans approximately 880 km², though this area fluctuates due to erosion and seasonal flooding. The island lies between 26°45'N to 27°12'N latitude and 93°39'E to 94°35'E longitude. Majuli's ecosystem includes wetlands, grasslands, agricultural fields, beels, and patches of riverine forests. The region experiences a humid subtropical climate with annual rainfall exceeding 2000 mm.

Field surveys

Pollinator diversity and abundance were recorded using transect walks and timed observations. Each transect measured 100 meters, and observations were performed between 7:00–11:00 AM when insect activity was highest.

Floral resource assessment

Flowering plant species and density were documented to evaluate resource availability.

Pollinator visitation rate

Crop flowers were observed for visitation frequency and pollination behavior.

Interviews with farmers

Traditional farming knowledge and perceptions of pollinators were collected. Data were analyzed to understand correlations between agricultural practices, floral resources, and pollinator activity.

Result and Discussion

Table 1: Relationship between crop diversity and Pollinating insect diversity

No of crop species	Crop diversity level	Crop combination	Dominant pollinator groups
1	Mono cropping	Rice only	Diptera
2	Two crop mixed	Rice+Pulses	Hymenoptera, Diptera
3	Three crop mixed	Rice+Pulses+Oilseeds	Hymenoptera, Diptera
4	Four crop mixed	Rice+PulsesRice+Pulses+Oilseeds+Vegetables	Hymenoptera, Diptera, Lepidoptera
≥5	Diverse cropping	Rice+PulsesRice+Pulses+Oilseeds+Vegetables+Fruits	Hymenoptera, Diptera, Lepidoptera, Coleoptera

Table 2: Relationship between Pollinating insect visitation rate, Natural fencing and Pollinating insect diversity.

Farming practice	Type of natural fencing	Vegetation complexity	Shannon diversity index (H')	Visitation rate (Flower/Min)
No fencing	Absent	Very low	1.43	2.1
Artificial fencing	Bamboo fencing	Low	1.80	3.1
Live fencing	Shrubs	Moderate	2.42	4.8
Natural fencing	Mixed hedges	High	2.88	6.2
Natural fencing with flowering trees	Native flowering trees + Climbers	Very high	3.11	7.1

Relationship between pollinating insect species diversity and farming species showed that diversity of pollinating insects depends on the crop diversity level. As crop diversity level increases, the diversity of pollinating insects also increases. The findings indicate a strong positive association between diversified cropping and pollinator presence. The availability of nectar and pollen is strongly linked to floral abundance (Hicks *et al*., 2016) [3]. Traditional systems with mixed crops, and native flowering plants supported higher pollinator abundance compared to monocultures. Richness of floral resources was not simply related to the number of species sown but was instead dependant on intra- specific competition between both sown and weed species (Hicks *et al*., 2016; Wassmuth *et al*., 2009) [3, 6]. Pollinator visitation rates were particularly high in farms adopting natural fencing, agroforestry, and reduced chemical inputs. Enhanced pollination resulted in improved fruit set, seed production, and overall crop yield. Declines in pollinator activity were recorded in areas with intensive pesticide use or limited floral diversity. The study demonstrates that traditional agricultural practices inherently support pollinator health through diversity, habitat heterogeneity, and ecological balance. The integration of traditional knowledge with modern conservation strategies offers a sustainable model for agriculture, particularly in regions facing environmental stress. It seems clear that the application of agroforestry practices has a great impact in promoting the diversity of floral resources in this formerly degraded area (Boldrini *et al*., 2017) [1]

Reviving traditional agricultural systems through pollinator conservation provides a low-cost, sustainable, and ecologically sound approach to enhancing agricultural productivity. Protecting pollinators not only benefits crop yields but also supports biodiversity and rural livelihoods

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