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Bird Community Structure in the South Kainakary and Pallithode Agroecosystems of Central Kerala

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KEYWORDS

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ABSTRACT:

Introduction: Birds are key bio-indicators of environmental quality and ecosystem health due to their sensitivity to habitat alteration and pollution. Agroecosystems, particularly in tropical regions, are increasingly exposed to anthropogenic pressures including chemical inputs, plastic waste accumulation, land-use transformation, and infrastructural expansion. Such stressors can influence avian diversity, abundance, and community structure. Central Kerala hosts diverse wetland-linked agroecosystems that differ in hydrological regimes (freshwater vs. saline), potentially affecting species assemblages and ecological stability. Understanding bird community responses in these landscapes is essential for evaluating ecological risks and informing sustainable management practices.

Objectives: 1. To assess and compare bird species diversity and community structure in freshwater (South Kainakary) and saline (Pallithode) agroecosystems. 2. To evaluate community composition using standard biodiversity indices. 3. To examine potential anthropogenic and environmental risk factors influencing avian distribution.

Methods: The study was conducted from January to December 2023 in two agroecosystems of Central Kerala: South Kainakary (freshwater) and Pallithode (saline). Monthly bird surveys were carried out using standardized line transect and direct observation methods during peak activity hours (morning; 6-10am). Species identification was performed using standard ornithological field guides.Community structure was analyzed using: Margalef Richness Index (DMg), Shannon–Wiener Diversity Index (H'), Simpson's Diversity Index (D), Berger–Parker Dominance Index (d) and Pielou's Evenness Index (J'). Comparative analysis was conducted to evaluate ecological variation between sites.

Results: A total of 92 bird species belonging to 15 orders and 38 families were recorded. Passeriformes was the most dominant order (24 species), whereas Columbiformes, Apodiformes, Podicipediformes, and Psittaciformes showed lower representation. Pallithode (saline agroecosystem) exhibited higher species richness and diversity (DMg = 8.75; H' = 2.43; J' = 0.54), indicating a relatively stable and heterogeneous bird community. In contrast, South Kainakary showed higher dominance values (Berger–Parker d = 0.48; Simpson D = 0.27), suggesting concentration of individuals among fewer species. Field observations revealed multiple anthropogenic stressors including land-use changes, plastic accumulation, domestic waste discharge, tourism disturbance, and hazards from electric transmission lines and communication towers, potentially posing chemical and environmental health risks to avifauna.

Conclusions: The saline agroecosystem of Pallithode supports greater avian diversity and evenness compared to the freshwater agroecosystem of South Kainakary, which shows higher species dominance. Anthropogenic pressures, including pollution and infrastructural expansion, may influence community structure and ecological stability. Continuous monitoring and integrated habitat management strategies are essential to mitigate environmental risks and sustain avian biodiversity in agroecosystems of Central Kerala.

1. Introduction

Agricultural landscapes support a wide range of biodiversity, and organic farming is often considered beneficial for maintaining ecological integrity. However, the influence of agricultural land-use intensity—particularly at regional scales—remains insufficiently addressed (Kirk *et al*., 2020). Birds play significant roles in agriculture, providing ecosystem services such as pest control, pollination, seed dispersal, and nutrient cycling,

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alongside occasional negative impacts like crop depredation (Pejchar *et al*., 2018). Their reproduction and persistence within agroecosystems are vital for sustaining ecological balance, regulating pest populations, and conserving overall biodiversity (Belkhiri *et al.,* 2024). Despite their importance, global evidence indicates a continuing decline in avian diversity within agricultural landscapes (Bhagwat *et al*., 2025), driven in part by the extensive use of pesticides, which remains a major threat to farmland birds (Jiménez-Peñuela *et al.,* 2024). As agriculture expands and intensifies, it has increasingly become a major driver of biodiversity loss (Molina-Mora *et al.,* 2024). Habitat characteristics such as vegetation composition, structural complexity, and resource availability strongly influence bird diversity and distribution in agricultural and wetland ecosystems (Gumede *et al*., 2022). Understanding these habitat associations is particularly important in transformed landscapes where a mosaic of vegetation types coexists. Agroecology has recently gained global attention as an alternative agricultural model aimed at mitigating the environmental and socioeconomic impacts of conventional, high-input farming systems (Hall *et al.,* 2022). By promoting ecologically sustainable pest management and enhancing biodiversity, agroecological approaches offer opportunities to reconcile crop production with conservation goals (Connor *et al*., 2024).

In India, rapid urbanization and expanding city limits have fragmented farmlands, resulting in a steady reduction in cultivable area (Menon *et al.,* 2020). Simultaneously, wetland degradation often due to poorly planned management or restoration has reduced available foraging grounds for birds especially waterbirds. As a consequence, many species increasingly depend on adjacent agricultural fields for feeding, creating potential conflicts between agricultural productivity and conservation priorities (Zhong *et al*., 2025). Given these global and regional trends, understanding bird–habitat relationships in diverse agroecosystems are essential for biodiversity conservation and sustainable agricultural management. The present study examines the avian diversity, community structure, and habitat use in two contrasting agroecosystems of Central Kerala: South Kainakary, a freshwater agroecosystem within the Kuttanad region, and Pallithode, a saline agroecosystem located along the coastal belt. By assessing species richness, diversity indices, and habitat associations from January to December 2023, this study provides insights into how habitat characteristics and environmental gradients shape bird communities in these distinct agricultural landscapes.

2. Objectives

1. To assess and compare bird species diversity and community structure in freshwater (South Kainakary) and saline (Pallithode) agroecosystems.

2. To evaluate community composition using standard biodiversity indices.

3. To examine potential anthropogenic and environmental risk factors influencing avian distribution.

3.Materials and Methods

Study Area

This research focused on bird diversity in two contrasting agroecosystems—South Kainakary (freshwater) and Pallithode (saline)—located in central Kerala, India.

The freshwater agroecosystem was represented by South Kainakary (Lat: 9°27′48.96″ N, Long: 76°22′11.68″ E), a village in Kuttanad Taluk, Alappuzha District, central Kerala. The area features extensive paddy fields, canals, and wetlands that support a diverse variety of bird species.

The saline agroecosystem was represented by Pallithode (Lat: 9°46′45.29″ N, Long: 76°17′16.02″ E), located in Thuravoor Thekku, Alappuzha District, central Kerala. Due to its coastal location, this site experiences periodic saline intrusion and includes agricultural lands affected by brackish water conditions.

Sampling and Observation of Birds

Systematic bird sampling was conducted from January to December 2023, primarily during the morning hours between 06:00 and 10:00, following Verner and Ritter (1986). Monthly surveys were carried out using the point count method described by Ralph *et al.* (1995) to document species richness, abundance, and overall avian diversity, including both resident and migratory species (Hamel *et al*., 1996). In the freshwater and saline agroecosystems, ten-point count stations were established in each site and each point had a 50-m radius (Pendleton, 1995). Surveys were conducted only on clear days to ensure optimal visibility and detectability (Verner & Ritter, 1986). At each point, all birds seen or heard within the 50-m radius were recorded during a 15-

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minute observation period. A 50-m minimum spacing was maintained between points to avoid double counting and minimize spatial overlap (Fuller & Langslow, 1984). The 15-minute count duration was selected to maximize the detection of cryptic or less conspicuous species and to ensure adequate time for accurate identification in a species-rich environment.

A limited-radius approach was used to record only those birds actively using the habitat. Birds flying or interacting above 25 m from the tallest vegetation or structure within the plot were excluded as flyovers, as they were not considered part of the local bird community (Huff, 2000). Observations were made using Nikon 10×50 binoculars, and photographic documentation was obtained using a Nikon Coolpix P1000 camera. Species identification followed "The Book of Indian Birds" (Ali, 2002) and "Birds of the Indian Subcontinent" (Grimmett *et al.*, 2000). Anthropogenic pressures influencing both agroecosystems were assessed using the Direct Observation Method following the approach described by Hoves and Bakewell (1989). During each field survey, all visible human activities that could alter habitat conditions or affect bird presence such as farming operations, fishing, livestock grazing, waste deposition, sand extraction, and other forms of disturbance were systematically noted along predefined observation points.

Data Analysis

Avian diversity in the two agroecosystems was quantified using standard biodiversity indices, including Margalef Richness Index (Margalef, 1958), Berger–Parker Dominance Index (Berger & Parker, 1970), Shannon–Wiener Diversity Index (Shannon & Wiener, 1949), Simpson's Index (D), and Pielou's Evenness Index (Pielou, 1969). These indices were used to evaluate species richness, dominance patterns, overall diversity, and evenness, providing a comprehensive assessment of bird community structure across the two contrasting habitats.

Margalef Richness Index (Margalef, 1958): Measures species richness (how many species are present) relative to the total number of individuals

$$D = \frac{(S-1)}{\ln(N)}$$

S=total number of species, N= total number of individuals

Berger–Parker Dominance Index (Berger & Parker, 1970): Measures the proportion of individuals belonging to the most abundant species

$$d = \frac{N_{\max}}{N}$$

Nmax =number of individuals of the most abundant species, N = total number of individuals

Shannon–Wiener Diversity Index (Shannon & Wiener, 1949): a measure of species diversity in a community.

$$H = -\Sigma pi * \ln(pi)$$

H — Shannon diversity index, p_i — Proportion of individuals of i-th species in a whole community, $\sum$ — sum symbol; and

$$p_i = \frac{n}{N}$$

n — Individuals of a given species; and N — Total number of individuals in a community

Simpson's Index (D): Simpson's diversity index (SDI) measures community diversity

$$D = 1 - \frac{\Sigma n(n-1)}{N(N-1)}$$

n = number of individuals of each species, N = total number of individuals of all species

Pielou's Evenness Index (Pielou, 1969): Measures how evenly individuals are distributed among species.

$$J' = \frac{H'}{\ln(S)}$$

H'= Shannon-Wiener diversity index, S= number of species

4. Results

Bird Species Composition in the Two Agroecosystems

A total of 92 bird species belonging to 15 orders and 38 families were recorded across the two agroecosystems surveyed. Passeriformes was the most species-rich order, consisting of 14 families and 24 species, followed by Charadriiformes with 19 species across 5 families. The least represented orders—Apodiformes, Podicipediformes, Psittaciformes, and Columbiformes were each represented by a single species. At South Kainakary (freshwater agroecosystem), 48 species

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belonging to 14 orders and 29 families were documented. Passeriformes was the dominant order, comprising 10 families and 14 species, followed by Pelecaniformes with 9 species in 2 families. Several orders, including Anseriformes, Gruiformes, Ciconiiformes, Psittaciformes, and Columbiformes, were represented by only one species each. At Pallithode (saline agroecosystem), 90 species were recorded, spanning 15 orders and 38 families. Passeriformes again emerged as the largest order (14 families; 23 species), followed by Charadriiformes (5 families; 17 species).Among the recorded species, the majority were classified as Least Concern (LC) under the IUCN Red List. However, six species—Black-tailed Godwit (*Limosa limosa*), Asian Woolly-necked Stork (*Ciconia episcopus*), Painted Stork (*Mycteria leucocephala*), Oriental Darter (*Anhinga melanogaster*), Black-headed Ibis (*Threskiornis melanocephalus*), and Spot-billed Pelican (*Pelecanus philippensis*) were categorized as Near Threatened (NT). In addition, the Black-capped Kingfisher (*Halcyon pileata*) was recorded as Vulnerable (VU) in the study area. The complete checklist of bird species presented in Table 1. Family-wise analysis revealed that Ardeidae was the most dominant family in both ecosystems—14.29% in South Kainakary and 12.22% in Pallithode. In the freshwater agroecosystem, the next prominent families were Alcedinidae (6.13%) and Corvidae (6.12%), whereas in the saline agroecosystem, Rallidae (7.78%) was the second most dominant family. The complete family-wise species distribution is presented in Table 2.

Biodiversity Indices of South Kainakary and Pallithode

A comparative analysis of bird diversity using Margalef Richness (DMg), Berger–Parker Dominance (d), Shannon–Wiener Index (H′), Simpson Index (D), and Pielou's Evenness (J′) revealed clear differences between the two agroecosystems. The Pallithode (saline agroecosystem) recorded the highest values for: Margalef Richness: 8.75, Shannon–Wiener Index: 2.43, Pielou's Evenness: 0.54. These results indicate a more species-rich, diverse, and evenly distributed bird community. In contrast, South Kainakary (freshwater agroecosystem) showed higher: Berger–Parker Dominance: 0.48 and Simpson Index: 0.27 reflecting a greater dominance of a few species and lower overall diversity. The biodiversity indices for both ecosystems are summarized in Table 3.

Anthropogenic Disturbance Factors

Several anthropogenic disturbance factors were documented in both South Kainakary (Freshwater agroecosystem) and Pallithode (Saline agroecosystem). The major disturbances observed include:

1. Land conversion, particularly for agriculture, settlements, and associated land-use changes.

2. Domestic and plastic waste accumulation, leading to pollution of wetland and agricultural habitats.

3. Use of pesticides and fertilizers contributes to chemical contamination and alteration of water quality.

4. Water and noise pollution arising from human activities and local transport systems.

5. Tourism and recreational activities, including boating, hunting, and disturbances associated with bird watching.

6. Infrastructure development, such as the installation of electric lines and communication towers.

These disturbance factors collectively contribute to habitat degradation and may significantly influence avian diversity, species distribution, and overall ecosystem health at both study sites.

Table 1. Checklist of bird species recorded from South Kainakary (Freshwater Agroecosystem) and Pallithode (Saline Agroecosystem)

Sl. No.	Order & Family	Scientific Name	Common Name	South Kainakary	Pallithode	Red List Status
1	**Anseriformes** Anatidae	*Dendrocygna javanica*	Lesser Whistling-Duck	+	+	LC
		Nettapus coromandelianus	Cotton Pygmy-Goose	-	+	LC
		Spatula querquedula	Garganey	-	+	LC
		Anas poecilorhyncha	Indian Spot-billed Duck	-	+	LC

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		Anas acuta	Northern Pintail	-	+	LC
2	**Columbiformes** Columbidae	*Columba livia*	Rock Pigeon	+	+	LC
3	**Cuculiformes** Cuculidae	*Centropus sinensis*	Greater Coucal	+	+	LC
		Eudynamys scolopaceus	Asian Koel	-	+	LC
4	**Apodiformes** Apodidae	*Apus affinis*	Little Swift	-	+	LC
5	**Gruiformes** Rallidae	*Lewinia striata*	Slaty-breasted Rail	-	+	LC
		Gallinula chloropus	Eurasian Moorhen	-	+	LC
		Fulica atra	Eurasian Coot	-	+	LC
		Porphyrio poliocephalus	Gray-headed Swamphen	-	+	LC
		Amaurornis phoenicurus	White-breasted Waterhen	+	+	LC
		Zapornia fusca	Ruddy-breasted Crake	-	+	LC
		Zapornia pusilla	Baillon's Crake	-	+	LC
6	**Charadriiformes** Recurvirostridae	*Himantopus himantopus*	Black-winged Stilt	+	+	LC
	Charadriidae	*Vanellus indicus*	Red-wattled Lapwing	+	+	LC
		Anarhynchus atrifrons	Tibetan Sand-Plover	+	+	LC
	Jacanidae	*Hydrophasianus chirurgus*	Pheasant-tailed Jacana	-	+	LC
		Metopidius indicus	Bronze-winged Jacana	-	+	LC
	Scolopacidae	*Limosa limosa*	Black-tailed Godwit	-	+	NT
		Actitis hypoleucos	Common Sandpiper	+	+	LC
		Tringa ochropus	Green Sandpiper	-	+	LC
		Tringa stagnatilis	Marsh Sandpiper	-	+	LC
		Tringa glareola	Wood Sandpiper	+	+	LC
		Tringa nebularia	Common Greenshank	-	+	LC
	Laridae	*Chroicocephalus ridibundus*	Black-headed Gull	-	+	LC
		Chroicocephalus brunnicephalus	Brown-headed Gull	-	+	LC
		Sternula albifrons	Little Tern	-	+	LC
		Gelochelidon nilotica	Gull-billed Tern	-	+	LC
		Chlidonias hybrida	Whiskered Tern	+	+	LC
		Thalasseus bergii	Great Crested Tern	-	+	LC
7	**Podicipediformes**	*Tachybaptus ruficollis*	Little Grebe	+	+	LC

	Podicipedidae					
8	**Ciconiiformes** Ciconiidae	*Anastomus oscitans*	Asian Openbill stork	+	+	LC
		Ciconia episcopus	Asian Woolly-necked Stork	-	+	NT
		Mycteria leucocephala	Painted Stork	-	+	NT
9	**Suliformes** Anhingidae	*Anhinga melanogaster*	Oriental Darter	+	+	NT
	Phalacrocoracidae	*Microcarbo niger*	Little Cormorant	+	+	LC
		Phalacrocorax fuscicollis	Indian Cormorant	+	+	LC
10	**Pelecaniformes** Threskiornithidae	*Plegadis falcinellus*	Glossy Ibis	+	+	LC
		Threskiornis melanocephalus	Black-headed Ibis	+	+	NT
		Platalea leucorodia	Eurasian Spoonbill	-	+	LC
	Ardeidae	*Botaurus sinensis*	Yellow Bittern	-	+	LC
		Nycticorax nycticorax	Black-crowned Night Heron	-	+	LC
		Egretta garzetta	Little Egret	+	+	LC
		Egretta gularis	Western Reef-Heron	-	+	LC
		Butorides striata	Striated Heron	-	+	LC
		Ardeola grayii	Indian Pond-Heron	+	+	LC
		Ardea coromanda	Eastern Cattle-Egret	+	+	LC
		Ardea alba	Great Egret	+	+	LC
		Ardea intermedia	Medium Egret	+	+	LC
		Ardea cinerea	Grey Heron	+	+	LC
		Ardea purpurea	Purple Heron	+	+	LC
	Pelecanidae	*Pelecanus philippensis*	Spot-billed Pelican	-	+	NT
11	**Accipitriformes** Pandionidae	*Pandion haliaetus*	Osprey	+	+	LC
	Accipitridae	*Milvus migrans*	Black Kite	+	+	LC
		Haliastur indus	Brahminy Kite	+	+	LC
12	**Coraciiformes** Meropidae	*Merops orientalis*	Asian Green Bee-eater	-	+	LC
		Merops philippinus	Blue-tailed Bee-eater	+	+	LC
		Merops persicus	Blue-cheeked Bee-eater	+	-	LC
	Alcedinidae	*Alcedo atthis*	Common Kingfisher	+	+	LC
		Pelargopsis capensis	Stork-billed Kingfisher	+	+	LC

		Halcyon smyrnensis	White-throated Kingfisher	+	+	LC
		Halcyon pileata	Black-capped Kingfisher	-	+	VU
13	**Piciformes** Megalaimidae	*Psilopogon viridis*	White-cheeked Barbet	-	+	LC
	Picidae	*Dinopium benghalense*	Black-rumped Flameback	+	+	LC
14	**Psittaciformes** Psittaculidae	*Psittacula krameri*	Rose-ringed Parakeet	+	+	LC
15	**Passeriformes** Oriolidae	*Oriolus kundoo*	Indian Golden Oriole	-	+	LC
		Oriolus xanthornus	Black-hooded Oriole	-	+	LC
	Artamidae	*Artamus fuscus*	Ashy Woodswallow	+	+	LC
	Dicruridae	*Dicrurus macrocercus*	Black Drongo	+	+	LC
		Dicrurus aeneus	Bronzed Drongo	+	-	LC
	Laniidae	*Lanius cristatus*	Brown Shrike	+	+	LC
	Corvidae	*Dendrocitta vagabunda*	Rufous Treepie	+	+	LC
		Corvus splendens	House Crow	+	+	LC
		Corvus macrorhynchos	Large-billed Crow	+	+	LC
	Cisticolidae	*Orthotomus sutorius*	Common Tailorbird	-	+	LC
		Prinia socialis	Ashy Prinia	+	+	LC
		Prinia inornata	Plain Prinia	+	+	LC
	Acrocephalidae	*Iduna caligata*	Booted Warbler	-	+	LC
		Acrocephalus dumetorum	Blyth's Reed Warbler	-	+	LC
		Acrocephalus stentoreus	Clamorous Reed Warbler	-	+	LC
	Hirundinidae	*Hirundo rustica*	Barn Swallow	+	+	LC
	Pycnonotidae	*Pycnonotus cafer*	Red-vented Bulbul	+	+	LC
	Sturnidae	*Acridotheres tristis*	Common Myna	+	+	LC
		Acridotheres fuscus	Jungle Myna	-	+	LC
	Muscicapidae	*Copsychus saularis*	Oriental Magpie-Robin	+	+	LC
	Dicaeidae	*Dicaeum erythrorhynchos*	Pale-billed Flowerpecker	-	+	LC
	Nectariniidae	*Leptocoma zeylonica*	Purple-rumped Sunbird	+	+	LC
	Motacillidae	*Motacilla maderaspatensis*	White-browed Wagtail	-	+	LC
		Anthus rufulus	Paddyfield Pipit	-	+	LC

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Table 2. Family-wise distribution (%) of bird species at South Kainakary (Freshwater agroecosystem) and Pallithode (Saline agroecosystem)

Sl. No	Order	Family	Family-wise distribution of birds	
			South Kainakary (Freshwater agroecosystem)	**Pallithode (Saline agroecosystem)**
1.	**Anseriformes**	Anatidae	2.04%	5.59%
2.	**Columbiformes**	Columbidae	2.04%	1.11%
3.	**Cuculiformes**	Cuculidae	2.04%	2.22%
4.	**Apodiformes**	Apodidae	0	1.11%
5.	**Gruiformes**	Rallidae	2.04%	7.78%
6.	**Charadriiformes**	Recurvirostridae	2.04%	1.11%
		Charadriidae	4.08%	2.22%
		Jacanidae	0	2.22%
		Scolopacidae	4.08%	6.68%
		Laridae	2.04%	6.68%
7.	**Podicipediformes**	Podicipedidae	2.04%	1.11%
8.	**Ciconiiformes**	Ciconiidae	2.04%	3.33%
9	**Suliformes**	Anhingidae	2.04%	1.11%
		Phalacrocoracidae	4.09%	2.22%
10.	**Pelecaniformes**	Threskiornithidae	4.08%	3.33%
		Ardeidae	14.29%	12.22%
		Pelecanidae	0	1.11%
11.	**Accipitriformes**	Pandionidae	2.04%	1.11%
		Accipitridae	4.08%	2.22%
12.	**Coraciiformes**	Meropidae	4.08%	2.22%
		Alcedinidae	6.13%	4.44%

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13.	**Piciformes**	Megalaimidae	2.04%	1.11%
		Picidae	2.04%	1.11%
14.	**Psittaciformes**	Psittaculidae	2.04%	1.11%
15.	**Passeriformes**	Oriolidae	0	2.22%
		Artamidae	2.04%	1.11%
		Dicruridae	4.08%	1.11%
		Laniidae	2.04%	1.11%
		Corvidae	6.12%	3.33%
		Cisticolidae	4.08%	3.33%
		Acrocephalidae	0	3.33%
		Hirundinidae	2.04%	1.11%
		Pycnonotidae	2.04%	1.11%
		Sturnidae	2.04%	2.22%
		Muscicapidae	2.04%	1.11%
		Dicaeidae	0	1.11%
		Nectariniidae	2.04%	1.11%
		Motacillidae	0	2.22%

Table 3. Biodiversity indices of the two agroecosystems

Agroecosystems	**Margalef Richness (DMg)**	**Berger-Parker Dominance (d)**	**Shannon-Wiener Index (H')**	**Simpson Index (D)**	**Pielou's Evenness (J')**
South Kainakary (Freshwater agroecosystem)	5.05	0.48	1.97	0.27	0.51
Pallithode (Saline agroeosystem)	8.75	0.41	2.43	0.19	0.54

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Fig. 1: Species richness at South Kainakary (Freshwater agroecosystem) and Pallithode (Saline agroecosystem)

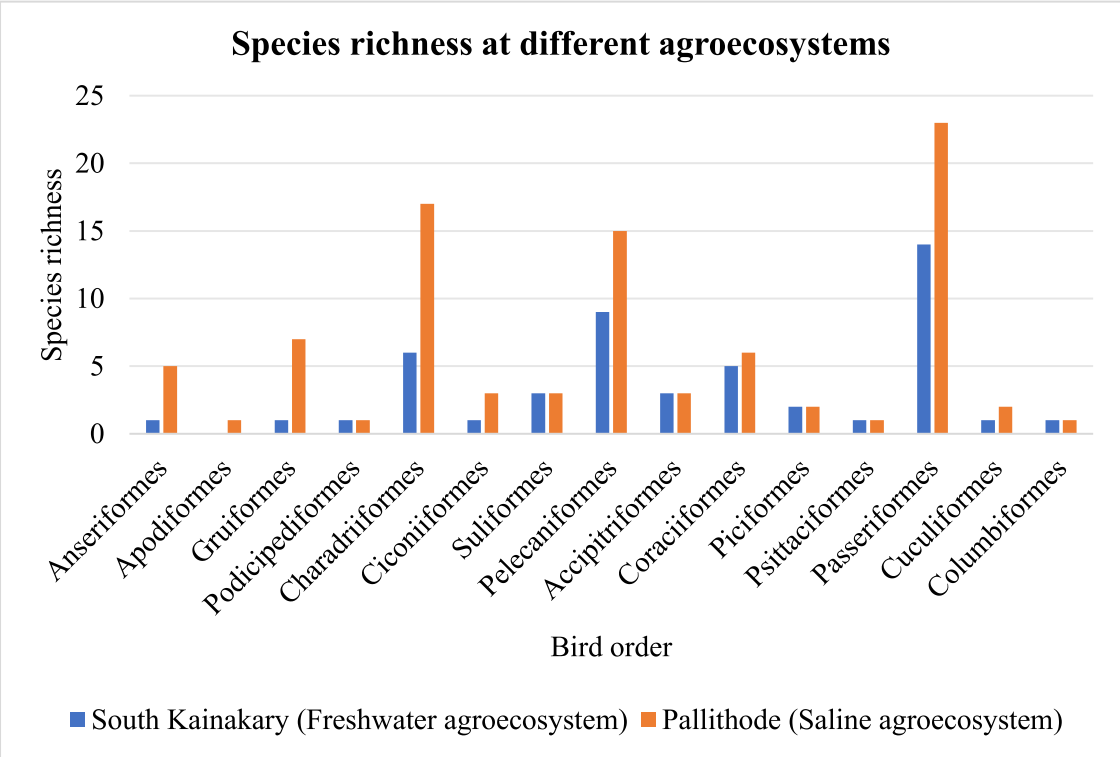

Fig. 2: Residential status of birds at South Kainakary (Freshwater agroecosystem)

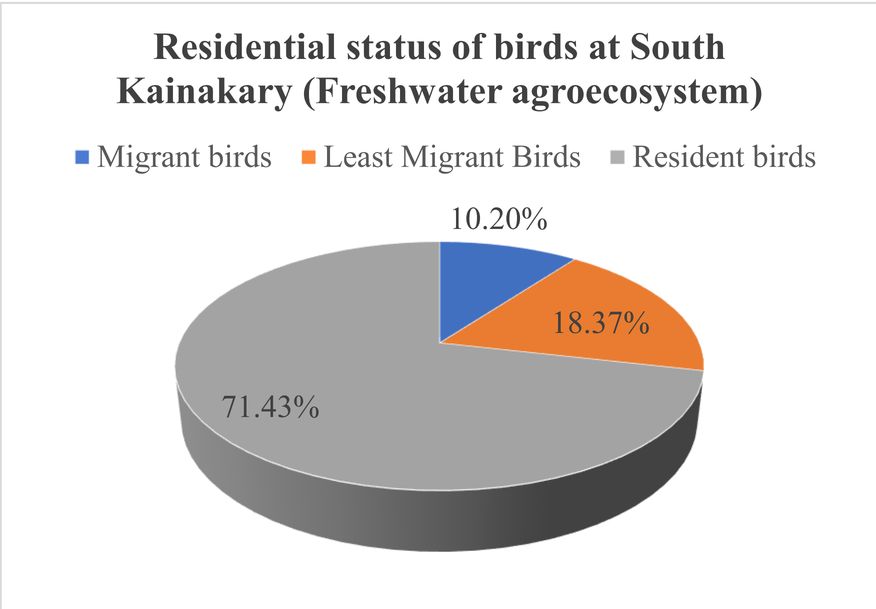

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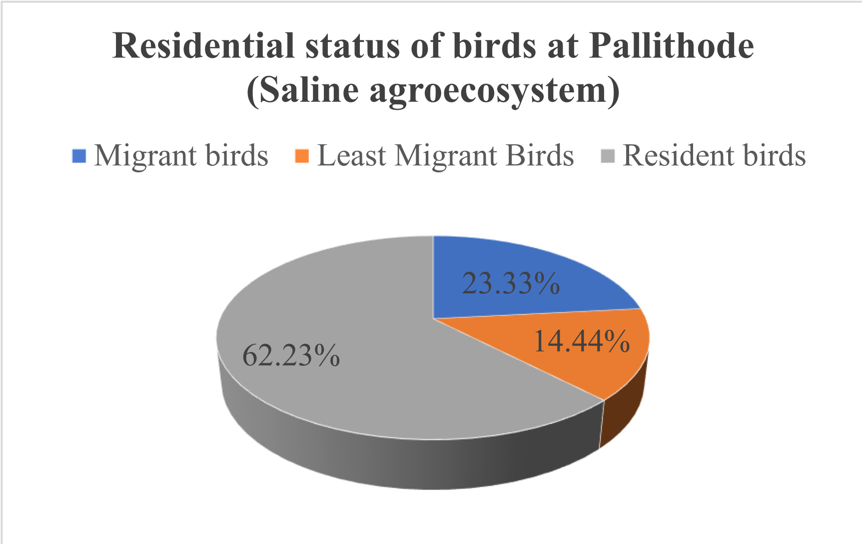
Fig 3: Residential status of birds at Pallithode (Saline agroecosystem)



Discussion

Agriculture plays a dual role in shaping biodiversity: it can provide secondary habitats for a variety of species, while simultaneously posing threats to ecological systems through habitat fragmentation and land-use intensification (Gioiosa *et al*., 2025). Ecosystems with greater habitat heterogeneity typically support higher bird diversity due to the availability of diverse niches, whereas homogeneous environments tend to sustain fewer species (Muñoz-Pedreros *et al*., 2025). Farmland ecosystem services are often driven by ecological functions performed by specific biodiversity groups, including birds, which act as indicators of ecological integrity (García *et al*., 2024). Research over recent decades have predominantly evaluated the impacts of industrial agriculture on biodiversity (Molina-Mora *et al*., 2024). One of the study was in Europe, Farmland birds, widely regarded as indicators of ecological health, are declining, in part due to habitat simplification and loss. Singular Point Elements in the Landscape (SPEL)—including isolated trees, shrubs, and pylons—play an important role in supporting avian diversity by providing essential perching, nesting, and foraging sites (Pustkowiak *et al*., 2025). In developing countries, rapid land-use changes further contribute to avian habitat degradation (Chen *et al*., 2025). Intensified farming practices also alter the life-history traits and functional diversity of bird communities. In many agricultural regions where field drainage systems are implemented to maximize crop yield, associated drainage ditches, hedgerows, and banks offer valuable riparian habitats that support a variety of bird species (Mostajeran *et al.*, 2025). These aquatic corridors are especially important as they provide energy-rich emergent insects an essential food pulse for many birds at critical life stages (Rideout *et al*., 2025).

Pre-harvested rice fields, for example, are known to support higher bird abundance and species richness compared to plowed, flooded, or post-harvested fields, highlighting their suitability for farmland birds (Menon *et al.*, 2020). Long-term ecological responses to agricultural landscapes have also been documented. A 27-year study comprising 4,264 bird captures from the Amazon reported that harsh dry seasons significantly lowered the survival of 24 out of 29 species, disproportionately affecting long-lived taxa (Wolfe *et al*., 2025). Moreover, agricultural intensification and cropland expansion are considered major global threats to avian biodiversity. A recent global assessment of 862 species correlated with arable crop yield trends demonstrated that many species remain insufficiently understood in terms of their vulnerability to modern agricultural practices (Busana *et al*., 2025). In the present study conducted during 2023, a total of 92 avian species belonging to 15 orders and 38 families were recorded across two distinct agroecosystems. The family Ardeidae emerged as the most dominant, while Passeriformes showed the highest species richness at both sites. Figure 1 illustrates the species richness across freshwater and saline agroecosystems in Central Kerala. The richness observed here is considerably higher than that reported in an earlier study, which documented only 15 species from 4 orders and 6 families, with Charadriiformes dominating (Andrimida *et al*., 2024).

Similarly, while a freshwater wetland study reported a Shannon diversity index of 2.08 (Narayanan *et al*., 2023), the present assessment found that the saline agroecosystem exhibited a notably higher Shannon index, indicating greater species diversity and evenness. This aligns with findings from Miotto *et al.* (2023), who reported Charadriiformes as the dominant order in their study area, with 41 species in the dry season and 39 in the rainy season. Migration patterns varied significantly between the two sites. At South Kainakary (freshwater agroecosystem), 10.20% of the species were migratory, 18.37% were partial migrants, and 71.43% were resident species (Fig. 2). In contrast, Pallithode (saline agroecosystem) supported a higher proportion of migratory birds, with 23.33% migratory, 14.44% partial migrants, and 62.23% resident species (Fig. 3). This higher influx of migratory species in Pallithode may be attributed to its coastal characteristics, greater habitat openness, and enhanced availability of foraging sites typical of saline agroecosystems.

Conclusion

This study demonstrates that the agroecosystems of South Kainakary and Pallithode in Central Kerala support a diverse assemblage of avian species, reflecting the influence of habitat heterogeneity and land-use characteristics. Pallithode, the saline agroecosystem, exhibited greater species richness, diversity, and evenness, whereas South Kainakary, the freshwater agroecosystem, supported higher species abundance, indicating contrasting ecological dynamics between the two systems. The findings highlight the importance of wetland–agriculture interfaces in sustaining bird diversity and emphasize the need for habitat-sensitive agroecological management. Protecting these multifunctional landscapes is essential for maintaining avian biodiversity while supporting sustainable agricultural practices in the region.

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