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Population size and ecological behaviour of cattle egret (*Bubulcus ibis*) in Chelekleka Wetland, Ethiopia

[1]Temesgen Tigab & [2]Misganaw Enyew

Abstract

The cattle egret (Bubulcus ibis) is a widespread, medium-sized heron recognized for its ecological adaptability and significant role as an indicator species in wetland ecosystems. Despite its global distribution and extensive research on its ecology, limited data exist on its behavioral ecology in Ethiopia. Therefore, the objectives of this study were to investigate the activity patterns, foraging behavior, abundance, and seasonal habitat utilization of cattle egrets in the Chelekleka Wetland, a seasonally inundated area located near Debre Zeyit in the Ethiopian Rift Valley. Fieldwork was conducted across wet (June to August 2023) and dry (January to February 2024) seasons using direct observation methods, including scan sampling and focal animal sampling, across defined habitat blocks. Descriptive and inferential statistical methods were utilized to analyze the data. Counts revealed higher egret abundance during the wet season (n=5,441) compared to the dry season (n=3,335), highlighting seasonal fluctuations linked to habitat conditions and resource availability. Diurnal activity patterns showed significant variations across time slots and seasons, with feeding and flying being predominant during early and late hours. Foraging observations revealed diverse prey selection, including insects and small vertebrates, and frequent use of livestock pastures and farmlands. The observed seasonal variation in population size and habitat utilization of the cattle egret indicates that wetland hydrology and resource availability are key factors influencing the species' ecology. Therefore, it is recommended that Wetland conservation and management efforts be strengthened to maintain water levels and vegetation structure throughout the year, ensuring suitable foraging and breeding habitats.

Keywords: *conservation status, feeding habits, fauna, population size, seasonal variation*

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About the authors:
[1]Corresponding author. MSc in Ecological and Systematic Zoology. Genetic Resource Access and Benefit Sharing Research, Ethiopian Biodiversity Institute. Email: Temesgen.tigab@ebi.gov.et
[2]MSc in Ecological and Systematic Zoology. College of Natural and Computational Sciences, Addis Ababa University, Department of Zoological Sciences, P.O. Box 1176. Email: misganawenyew92@gmail.com

1. Introduction

Wetlands are among the most productive ecosystems on Earth, supporting diverse biological communities and providing critical habitat for many bird species, including waterbirds and waders (Pacific Birds Habitat Joint Venture, 2023). In Ethiopia, wetlands play a vital role in maintaining regional biodiversity, acting as important breeding, feeding, and stopover sites for both resident and migratory birds (Ethiopian Biodiversity Institute, 2023). Among the avian species commonly associated with wetland habitats is the cattle egret (*Bubulcus ibis*), a widely distributed bird known for its opportunistic foraging strategies and close association with grazing animals (Verma et al., 2021; Shen *et al*., 2025).

The cattle egret, among the most terrestrial members of the heron family, exhibit remarkable nutritional flexibility, consuming a wide range of prey depending on environmental conditions (McKilligan, 2005; Verma *et al.,* 2021). Several studies have shown that factors such as season, time of day, prey availability, and habitat characteristics significantly influence their feeding ecology (Cele *et al.,* 2025; Shen *et al.,* 2025). Large flocks are frequently observed foraging in recently plowed agricultural fields, where soil disturbance exposes abundant insect prey (Patankar et al., 2007; Kumar & Singh, 2022). Insects, including grasshoppers, crickets, flies, beetles, spiders, and moths, constitute the primary diet, supplemented by larger prey such as frogs, small fish, snakes, and occasionally nestlings or eggs of other birds.

The cattle egret has undergone a notable range expansion over the past century and is now widely distributed across Africa, Asia, the Americas, and parts of Europe (Kushlan & Hancock, 2005; Verma et al., 2021). Despite its ecological adaptability and global presence, localized studies on population size and ecological behaviour are crucial for understanding its specific role within ecosystems and its responses to environmental changes (Cele et al., 2025; Shen et al., 2025). In Ethiopia, particularly within the central highlands, such data remain scarce, highlighting the need for focused research on this species to inform conservation and habitat management strategies.

Chelekleka Wetland, located in the Rift Valley region of central Ethiopia, is an ecologically important site that supports a wide array of bird species. Despite the widespread distribution and adaptability of the cattle egret, there is limited information on its population size, ecological behaviour, and habitat use within Ethiopian wetlands, particularly in the central highlands. Most existing studies focus on foraging and diet in other regions, leaving a

knowledge gap regarding seasonal activity patterns, interactions with livestock, and responses to environmental changes in Ethiopia. Addressing this gap is crucial for informed conservation and management of wetland ecosystems such as Chelekleka Wetland.

2. Materials and Method

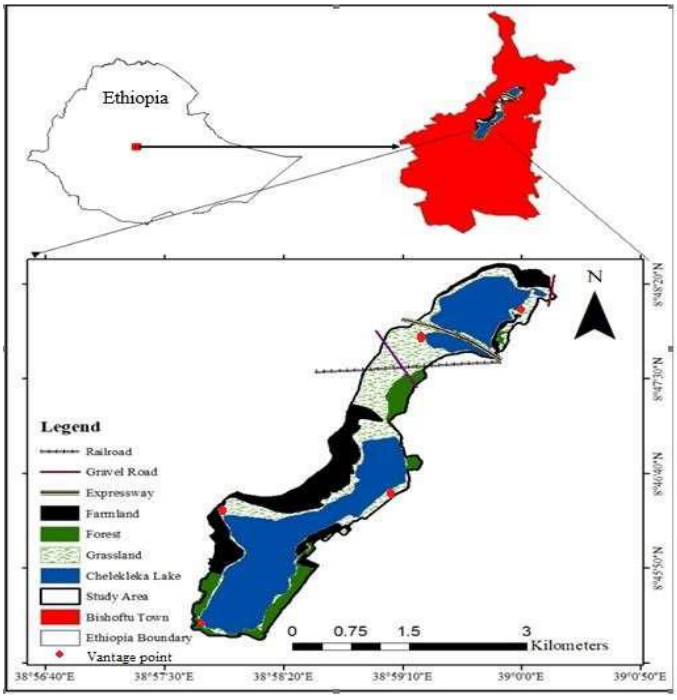
2.1 Description of the Study Area

Chelekleka wetlands are found near to Debre Zeyit which is a town lying southeast of Addis Ababa. Its elevation is 1,920 meters above sea level. It is situated at 8º39' 0" - 8º 53' 0" latitude and 38º49' 0" - 39º 3' 0" longitude and it is part of the Ethiopian Rift Valley ecosystem, located 51 km southeast of Addis Ababa (Esayas, 2017). The smaller Chelekleka region is located in Bishoftu, north of Babogaya Lake (Yeshimebet Mamo, 2006). In the town of Bishoftu (also known as Debre Zeyit), the five famed volcanic-crater lakes — Lake Bishoftu, Lake Hora, Lake Bishoftu Guda, Lake Kuriftu and Lake Babogaya — are well-known tourist attractions (Ethiopian Biodiversity Institute, 2023). Beyond these, additional lakes such as Lake Chelekleka, Hora Kilole Lake, Green Lake, Lake Ziquala and Cuban Made Lake lie on the outskirts of the town. Among these, Lake Chelekleka is a seasonally inundated pan located near the town Centre, which fills during the rainy season and draws large numbers of water birds following the Palaearctic migration from September through February (Gebrekidan, 2021).

Migratory birds augment resident species during this period, enriching the site with a diverse assemblage of Ethiopian and northern-hemisphere bird species. The surface area of the wetland fluctuates significantly year to year with precipitation from the surrounding highlands, and the site encompasses four distinct habitat types, forest, grassland, open water and human settlement (Bird Life International, 2001; Gebrekidan, 2021). As one travel along the Bishoftu-Addis Ababa route, it is possible to have to quick a plain area surrounding Lake Chelekleka as shown in Figure 1. In recent years, the natural characteristics of Lake Chelekleka have been altered due to the expansion of human settlement between the main road and the lake (Ethiopian Biodiversity Institute, 2023). The lake’s size fluctuates seasonally, forming small, sporadic swampy areas during the dry season and completely drying out between March and May (Gebrekidan, 2021).

Figure 1

Map of the Chelekleka wetland, Ethiopia (Mebrat Teklemariam, 2023GC)



2.2 Topography

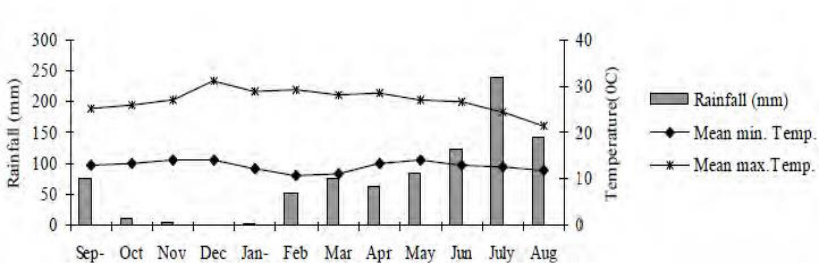
The study area topography has rolling hills, with an average elevation of 1920 meters above sea level. Luvisols, lepthosols, nithosols, vertisols, and cambisols are the most prevalent soil types the study area (Assefa, 2015).

2.3 Temperature/Rainfall

The climate of Chelekleka Wetland is characterized by mild and warm conditions, with December receiving the least precipitation at 5 mm and July the most at 232 mm (Aman, 2025; Shitu & Woundefiraw, 2024).

Figure 2

Average monthly rainfall (mm) and temperature (oC) of the Chelekleka Lake (2006-2016 GC)



Source: National Meteorological Service Agency (2016) and Kalkidan Esayas (2017)

2.4 Flora Diversity at Chelekleka Wetlands

The shallowness of the lake has resulted in a broad shoreline. The pan encourages the development of wetlands' plant life, which in turn makes the wetlands productive and life-sustaining. The flora of the wetland is dominated by aquatic vegetation, such as Typha sp., grass sp. (sedges and rushes), pondweeds, knotweeds and floating grasses. The study area is characterized by rugged topography with an altitude of 1800-1900 m a.s.l (Bird Life International, 2021). The annual rainfall and annual mean temperature ranges of the area are 5 - 232 mm and 8.5ºC - 28.3ºC, respectively (National Meteorological Service Agency, 2016).

2.5 Bird Diversity at Chelekleka Wetlands

The area is freshwater wetland and seasonally in undulated pan varying its size from year to year (Ethiopian Wildlife and Natural History Society (EWNHS), 1996), covering up to 24,000 ha (Bird Life International, 2021). The Chelekleka Wetland was originally supplied by runoff from Bishoftu town and the Teltele and Sofa highlands; however, the construction of flood control dykes in the feeder streams and channeling of runoff from the town to Lake Bishoftu has reduced the size of the wetland (EWNHS, 1996). It is an unprotected Important Bird Area, supporting hundreds of bird species in a highly degraded environment. Including endemics, the wetland harbors a variety of storks, herons, ducks, geese, waders, ibises, and birds of prey (EWNHS, 1996, 2010).

2.6 Local Farmer's Activity Around the Chelekleka Lake

Local farmers cultivating chickpeas, tomatoes, and cabbage along the edges of Chelekleka Wetland, alongside surrounding agro-industrial enterprises, significantly contribute to the wetland's ecological degradation. These agricultural and industrial activities introduce various pollutants into the wetland ecosystem. The application of insecticides and fertilizers in farming practices, combined with industrial effluents, leads to the accumulation of toxic chemicals in the wetland's substrate over time. This contamination poses a substantial risk to the wetland's biodiversity and the health of organisms' dependent on the region. Despite the evident environmental threats, there has been insufficient attention from stakeholders, particularly the government, to mitigate the rising sediment loads and chemical pollutants entering the wetland through surface and underground effluents (Assefa, 2015).

The Chelekleka Wetland has undergone significant ecological degradation due to various human activities, including changes in land use and land cover, agricultural practices,

and infrastructure development. These activities have led to increased sedimentation in the wetland, substantially altering its hydrology and water quality (Belete, 2018; Assefa & Eneyew, 2025).

3. Preliminary Survey

To collect relevant data, a preliminary survey was conducted in and around Chelekleka Wetland to provide a general overview of the habitat, with particular emphasis on cattle egrets. Local residents were consulted to gather information regarding the typical locations and habitats of the species. Based on this information, specific sites with high cattle egret abundance were identified, including nearby forests, shorelines, livestock pasture areas (including dung piles), and agricultural fields. The total count method was employed to estimate the population size of cattle egrets. For the purpose of the census, the study area was divided into four distinct ecosystems, and data were systematically recorded, distinguishing between juvenile (check) and adult individuals.

Initially, areas within Chelekleka Wetland exhibiting high concentrations of cattle egrets were identified, and the main roads and trails of the wetland were systematically surveyed, pausing at sites previously reported by local residents as having significant bird activity (Schulz-Neto, 2004). The locations of observed individuals were recorded using GPS and compass to accurately map areas of species abundance. Additionally, the movements of individual birds were tracked until dusk to determine their roosting sites and settling patterns.

Following the preliminary survey, two cattle egret roosting sites were identified on the two distinct wetlands separated by a trail. Given that cattle egrets are gregarious birds that congregate in communal areas for breeding and roosting, overall population estimates were obtained by simultaneously counting individuals as they flew to these roosting sites during designated time intervals. Direct counts allowed for accurate estimation of flock sizes in flight. For large congregations, sometimes numbering in the hundreds or thousands, subgroup counting methods were employed, as recommended by Bibby *et al*. (1993), using multiples of two, three, four, or five individuals.

Field data were collected based on the sites selected during the preliminary survey. Observations were conducted during both wet (June to August 2023) and dry (January to February 2024) seasons, for a total of 32 survey days, comprising 16 days in each season. Counts were carried out at three daily time periods, early morning (08:00–10:00), midday

(12:00–14:00), and late afternoon (16:00–18:00), to coincide with peak activity periods of cattle egrets (Spencer, 1963; Canterbury et al., 2000).

Diurnal Activity Patterns. The activity pattern of cattle egret was recorded using scan sampling method throughout the study period following (Altman, 1974). The technique was used to record a variety of activities during both the dry and wet seasons (Table 1). A flock of birds or a single bird was followed during the observation time from a distance of 5 to 10 meters. A five-minute gap was given each five-minute scan sampling. These activities were recorded by dividing the day into three times slots; morning 8:00 to 10:00, mid-day 12:00 to 14:00 and late afternoon 16:00 and 18:00. The activities were divided into five major categories following (Asokan *et al.,* 2010):

Table 1

Diurnal activities of cattle egret

Activity	Pattern
Feeding	When the bird is in a state of capturing prey and swallowing into the buccal chamber.
Scanning	When the bird is in a state of scanning surroundings actively.
Flying	When the bird is in a state of flight.
Preening	When the bird is in a state of comfort movements including feather shaking, wing flapping, bill cleaning, bill scratching, and body and tail shaking.
Resting	When the bird is in a state of dozing with head retracted and eyes closed.
Others	When the bird is in a state of activities listed above such as calling, showing agonistic activity, etc.

Foraging Behavior. In addition to feeding according to their nutritional needs, cattle egrets engage in behaviors such as sprinting, jumping, walking quickly, and capturing flying insects. When hunting high-energy vertebrate prey or feeding in environments lacking mammals, they typically forage independently, without the aid of beaters (Dolbeer *et al.*, 2020; Kahl, 2021). Using two-minute focal observations of foraging individuals during the wet and dry seasons, the foraging behavior of cattle egrets were sampled (Altman, 1974).

Repeated, standardized observations were conducted to gather information regarding foraging behavior (Paoloni *et al*., 2018). Direct observation of feeding sites provided useful data. The time spent feeding (head down) was meticulously tracked. Data on foraging

activities, including vigilance and aggressive or cooperative interactions, were collected. A bird was followed from a distance of 5 to 10 meters during data collection operations (Paoloni *et al*., 2018). Daily habitat utilization was monitored based on the cattle egret's behavior. The amount of time spent foraging per day was determined, and seasonal variations in habitat utilization were examined (Paoloni *et al*., 2018).

The abundance of food items in the area was quantified using a 1 meter by 1 meter quadrant (Plate 4). The quadrants were on grasslands at and food items were counted from each quadrant. A total of 16 quadrants were used in the study area during the wet and dry seasons.

Figure 3

Sampling quadrant

Photo source*:* Misganaw Enyew (2024)

4. Results

The collected data were presented in tables and graphs using Microsoft Excel. Comparisons of mean activity rates during the wet and dry seasons were performed using the Statistical Package for the Social Sciences (SPSS) version 25. A two-way analysis of variance (ANOVA) was employed to test for significant variations in activity patterns between different time slots and hours of the day. In this analysis, the dependent variable was the activity rate of the species (continuous), while the two independent variables were the time slot and hour of the day (categorical). An additional advantage of using a two-way ANOVA is that it allows

for testing of the interaction effect, which examines whether the effect of one independent variable on the dependent variable is influenced by the other independent variable. The level of significance was set at $p < 0.05$ for all statistical tests.

4.1 Population of Cattle Egrets

The current study revealed that the higher population of cattle egrets were recorded during the wet seasons (n=5441) while the during the dry season, lower number of egrets (n=3335) were recorded as shown in Table 2.

Table 2

Number of individuals in each season within three-day data

Day	Seasons			
	Wet	**Number**	**Dry**	**Number**
Day 1	Block 1	534	Block 1	350
	Block 2	600	Block 2	280
	Block 3	620	Block 3	300
	Total	**1754**	**Total**	**930**
Day 2	Block 1	640	Block 1	450
	Block 2	640	Block 2	400
	Block 3	560	Block 3	360
	Total	**1840**	**Total**	**1210**
Day 3	Block 1	600	Block 1	480
	Block 2	702	Block 2	335
	Block 3	645	Block 3	380
	Total	**2002**	**Total**	**1195**

4.2 Activity Patterns

Cattle egrets were observed engaging in different daily activities of feeding, scanning, preening, resting, flying and others activities during the wet seasons. It was observed that feeding comprised highest percentage (86.93%), followed by preening (12.17%), scanning (0.48%), resting (0.16%), flying (0.22%) while others (0.04%) comprised the lowest. Similarly, during the dry season feeding activity comprised the highest percentage (91.24%), followed by preening (6.60%), scanning (1.68%), resting (0.45%) and others (0.03%) also comprised the lowest as shown in Figure 3. It feeds all through the day, but in the early morning

and late afternoon, it feeds the most. Feeding groups frequently loaf with other birds in trees or on the ground close to the resting herd at midday and other periods when grazing stock pause to ruminate (Figure 7). In the late afternoon, the birds travel low over a watercourse from the feeding areas to the night roost place (Figure 6).

Figure 3

Percentage time spent for different activities in cattle egrets during the dry and wet seasons

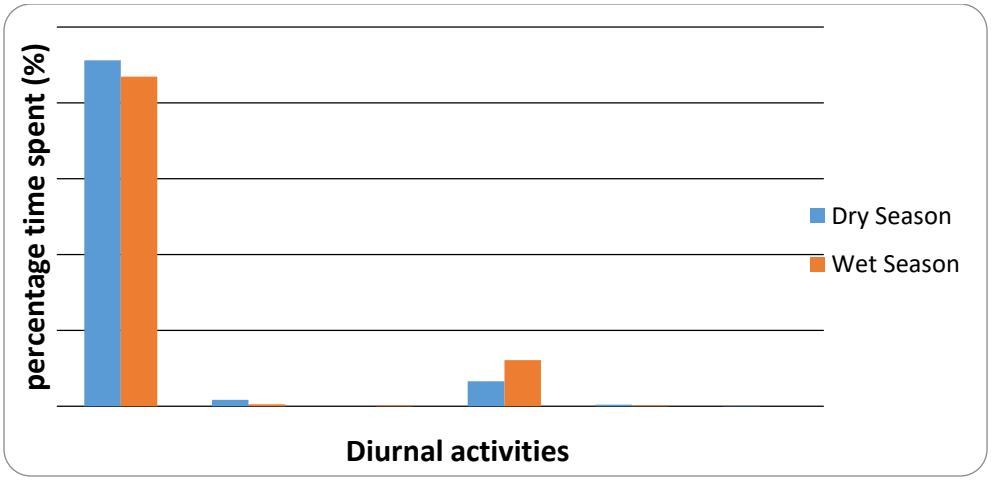


Table 3

Mean proportion of time allocated for different activities of cattle egret during wet and dry seasons.

Activity	Wet Season	Dry Season	F	P
Feeding	364±36	234±32	10.03	<0.05
Scanning	2±1	4±2	2.41	<0.05
Flying	0.69±1.03	0±0.0	3.86	<0.05
Preening	50±5	16.9±5	7.70	<0.05
Resting	0.92±1.18	1±1	8.42	<0.05
Others	0.15±0.55	0.08±0.27	3.74	<0.05

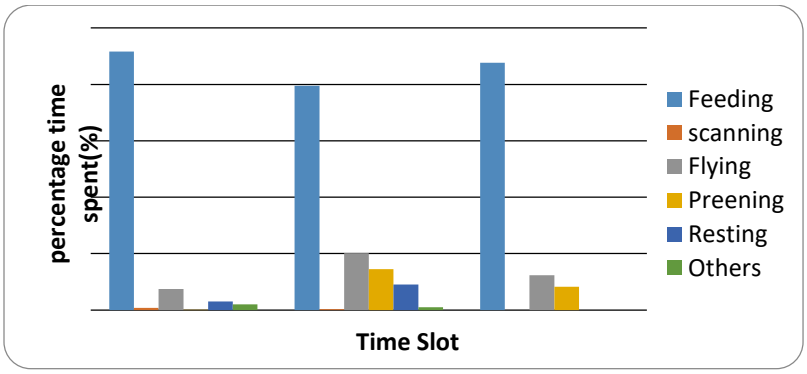
The activities of cattle egret varied in different hours of the day in the wet and dry seasons. Feeding was the most distinct activity than other activities in different hours of the day in both seasons. During the wet and dry seasons cattle egret showed highest rate of feeding between 8:00-10:00 hours than other hours of the day comprising 86.93% and 91.24%, respectively. However, there was statistically significant difference of activities between different hours of the day in both seasons. During the wet season, highest rate of flying was recorded between 12:00-14:00 hours and highest rate of preening was recorded between 12:00-

14:00 hours. Resting activity was highest between 12:00-14:00 hours and other activities recorded lowest rate between 16:00-18:00 hours.

The highest rate of feeding was recorded during early morning (8:00-10:00) hours. The highest rate of flying, preening and resting were recorded during a mid-day (12:00-14:00) hours, respectively. The lowest rate of feeding was recorded during mid-day (12:00-14:00) hours (Figure 4).

Figure 4

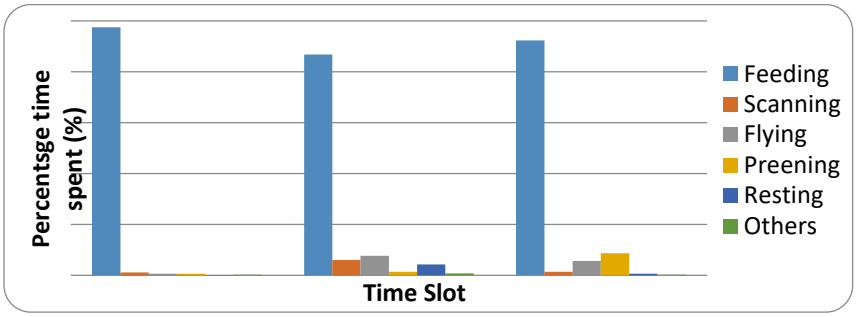
Activity patterns of cattle egret in three time slots during wet seasons



During the dry seasons the highest rate of preening was recorded late afternoon between 16:00-18:00 hours and the highest rate of flying was recorded during the mid-day (12:00-14:00 hours). The highest rate of scanning was recorded during the mid-day (12:00-14:00 hours). The lowest rate of feeding was recorded between 12:00-14:00 hours (Figure 5).

Figure 5

Activity patterns of cattle egret in three time slots during dry seasons

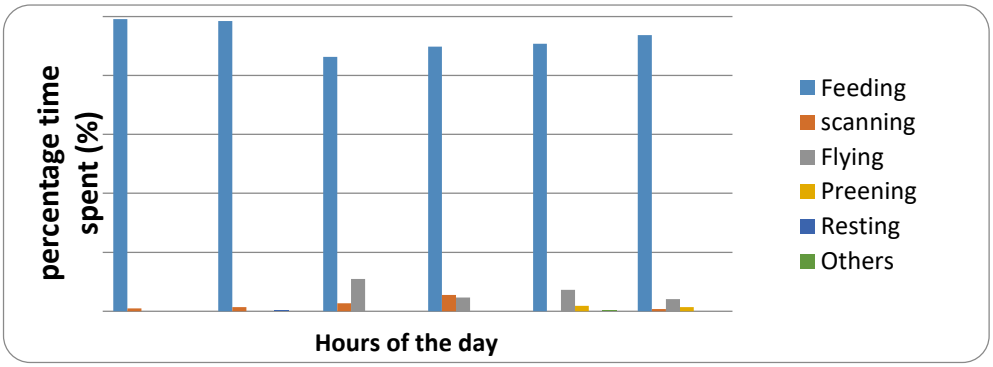


During the dry seasons the highest rate of preening was recorded late afternoon between 16:00-18:00 hours and the highest rate of flying was recorded during the mid-day (12:00-14:00

hours). The highest rate of scanning was recorded during the mid-day (12:00-14:00 hours). The lowest rate of feeding was recorded between 12:00-14:00 hours (Figure 6).

Figure 6

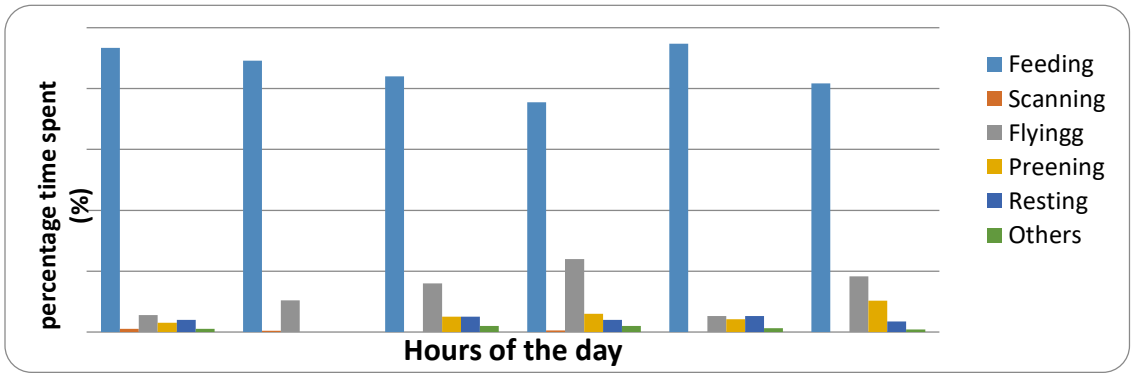
Diurnal activities of cattle egret in different hours of the day during the dry seasons



During the wet season highest rate of flying was recorded between 13:00-14:00 hours and followed by 17:00-18:00 hours and highest rate of scanning was recorded between 8:00-9:00 hours. The highest rate of resting was recorded between 12:00 -13:00 and 16:00-17:00 hours. The highest rate of preening was recorded between 17:00-18:00 hours. The rates of preening and resting peaked between 12:00 and 13:00 hours (Figure 7).

Figure 7

Diurnal activities of cattle egret in different hours of the during the wet seasons



4.3 Foraging Behaviour

Cattle egrets were seen grazing only in areas with broad grasslands. Cattle egrets were seen feeding among ducks, geese, and sacred ibis. The primary food source for cattle egrets was insects, and their diet was primarily dependent on their availability. The study revealed

that cattle egrets devoted the majority of their time to foraging, with feeding comprising the largest proportion of their activities 86.93% during the wet season and peaking at 91.24% in the dry season.

4.4 Distribution and Habitat Utilization of Cattle Egret

The study claims that cattle egrets were followed and fed in the grassland from dawn until dusk, after which they would depart and fly toward the wetland's rural areas. Unlike other herons, the cattle egret is usually found in fields and dry grassy areas, though it does occasionally feed in shallow water. This is because it depends more on terrestrial insects for its diet than it does on aquatic prey (Mullarney *et al*., 2001). The feeding habitat of cattle egrets was open grassy spaces like meadows (Del Hoyo *et al.,* 1992).

4.5. Food Type

According to the study, cattle egrets only ate insects, and sampling quadrants were used to repeatedly count the insects. The primary diet of cattle egrets consists of insects. They catch a wide range of insects from every environment that is accessible.

Table 4

Different food items of cattle egrets during wet and dry seasons

Quadrants	Name of insects	Wet Season	Dry Season
		Number	Number
Q1	Grasshoppers	6	4
	Flies	4	5
	Spiders	5	5
	Moths	2	3
	Beetles	7	5
Q2	Grasshoppers	8	5
	Flies	5	5
	Spiders	3	2
	Moths	6	3
	Beetles	4	4
Q3	Grasshoppers	3	7
	Flies	6	4
	Spiders	4	2
	Moths	2	2
	Beetles	5	5

5. Discussion

5.1 Population Variation Between Seasons

Recent studies have corroborated the findings of the present study, highlighting the influence of food availability and climatic conditions on the seasonal population dynamics of cattle egrets. For instance, Amissah et al. (2024) observed that the abundance of prey at foraging sites positively influences the feeding success of egrets, indicating that increased insect abundance during the wet season can lead to higher cattle egret populations. Similarly, Talbi (2023) reported that in Mediterranean climates, variations in rainfall significantly affect the foraging habitat of cattle egrets, with increased precipitation leading to more favorable conditions for foraging and, consequently, higher population numbers.

5.2 Activity Patterns and Diurnal Rhythm

The present study observed distinct seasonal differences in the daily activity budgets of cattle egrets. Feeding was the predominant activity in both seasons, accounting for 86.93% of time spent during the wet season and 91.24% during the dry season. These findings align with those of Siegfried (1971), who noted that cattle egrets in southern Africa exhibited increased feeding activity during cooler parts of the day, particularly in the mornings and evenings, likely due to reduced thermal stress and heightened prey visibility. Similarly, studies by Lo (1991) and Siegfried (1972) observed that cattle egrets in southern Africa consumed more earthworms during winter, correlating with their greater availability during that period.

Other behaviors, such as preening, flying, scanning, and resting, exhibited more pronounced seasonal variation. Preening activity was significantly higher during the wet season, possibly due to the need to maintain feather condition in response to wetter environmental conditions. This observation is consistent with findings by Blaker (1967), who reported that cattle egrets in southern Africa allocated more time to comfort activities, including preening, during periods of increased humidity.

Diurnal activity patterns also varied across the day. In both seasons, peak feeding activity occurred between 8:00–10:00 hours, aligning with cooler temperatures and optimal prey visibility. Midday periods (12:00–14:00 hours) were typically associated with increased flying, preening, and resting activities, likely due to thermal stress and reduced prey movement. Notably, flying activity peaked during midday, suggesting movements between foraging grounds and resting areas. The afternoon decline in feeding activity was followed by evening

movements toward roosting areas, consistent with observations by Mullarney et al. (2001). These patterns imply that daily time allocation in cattle egrets is strongly shaped by thermal and prey dynamics, a trait that enhances survival in variable tropical environments. Such behavioral scheduling optimizes foraging efficiency while minimizing physiological stress. The afternoon declines in feeding followed by evening roosting movements underscores the importance of proximity between feeding and roosting habitats, ensuring efficient energy use. Therefore, the persistence of both open foraging grounds and nearby wetlands for roosting is critical for sustaining healthy egret populations.

Statistical analyses further support these observations, indicating significant differences in most activity types, including feeding and preening, between the wet and dry seasons ($p < 0.05$). These results reflect the cattle egret's behavioral flexibility in response to environmental variability, as also noted by Blaker (1967), who emphasized the species' adaptability to changing environmental conditions.

5.3 Foraging Behavior and Food Type

Foraging behavior of cattle egrets in the Chelekleka Wetland was primarily concentrated in open grassy areas, where individuals were frequently observed following grazing livestock. This close association with cattle and other large herbivores enhances foraging efficiency, as the movement of livestock disturbs insects concealed within the vegetation, making them more accessible (Seedikkoya *et al.*, 2007). Such commensal foraging behavior has been widely documented across Africa and Asia, reflecting the species' behavioral adaptability and opportunistic feeding strategy (Kour & Sahi, 2021; Amissah et al., 2024).

The dominance of terrestrial insects, particularly grasshoppers (*Orthoptera*), beetles (*Coleoptera*), spiders (*Araneae*), and flies (*Diptera*), in the diet of cattle egrets observed during this study aligns with prior research emphasizing the species' preference for terrestrial prey over aquatic organisms (Talbi, 2023; Seedikkoya *et al*., 2007). This feeding specialization likely reflects both evolutionary adaptation and habitat availability, as cattle egrets often exploit agricultural landscapes and pastures where such prey is abundant (Bharti & Vishwas, 2023).

Interestingly, although the total abundance of insect prey was marginally higher during the wet season, cattle egrets devoted significantly more time to feeding during the dry season.

This extended foraging time may be linked to reduced prey capture efficiency under drier environmental conditions, when lower soil moisture limits insect mobility and availability (Kour & Sahi, 2021; Agidie *et al*., 2024). Another possible explanation is the increased energetic demand associated with thermoregulation and reproduction during dry months, requiring longer feeding bouts to meet metabolic needs (Amissah *et al.,* 2024).

Moreover, the spatial overlap between grazing livestock and foraging egrets illustrates the species' ecological dependence on mixed agricultural–wetland systems. As agricultural intensification and wetland degradation continue in many parts of Ethiopia, including the Bishoftu area, alterations in grazing patterns and pesticide use could significantly influence egret foraging success (Assefa *et al.,* 2025; Mesfin *et al.,* 2024).

5.4 Habitat Utilization and Distribution

Cattle egrets in the study area predominantly used open grasslands and pasturelands in close association with grazing livestock, demonstrating a clear preference for terrestrial foraging grounds over aquatic habitats. Observations that egrets follow cattle and other large grazers to exploit prey flushed by trampling corroborate a large body of work showing the species' commensal relationship with grazers and superior foraging success in such contexts (Seedikkoya *et al.,* 2007; Kour & Sahi, 2021). Recent research further supports this pattern: studies in urban and agricultural landscapes report that vegetation structure and the presence of grazers or mowing/vehicle disturbance strongly influence arthropod availability and thus egret foraging efficiency (Amissah *et al.,* 2024).

The daily movement documented in this study, from grazing fields during daylight to roosting sites near wetlands in the evening highlights the cattle egret's reliance on a mosaic of habitat types to satisfy different life-history requirements (foraging, safety, and roosting). Such spatiotemporal habitat coupling has been reported elsewhere and is considered a key component of the species' success in both natural and human-modified systems (Bharti & Vishwas, 2023; Gebrekidan *et al.,* 2024). This mobility and flexibility enable cattle egrets to exploit ephemeral prey resources across agricultural–wetland mosaics, but it also makes them sensitive to landscape changes: alterations in grazing regimes, wetland loss, or increased pesticide use can reduce prey availability and disrupt movement links between feeding and roosting sites (Talbi, 2023; Assefa & Eneyew, 2025).

Taken together, the present findings and recent literature reinforce that the cattle egret's habitat versatility its ability to forage effectively in open terrestrial habitats while roosting in nearby wetlands underpins both its ecological success and its vulnerability. Management strategies that maintain heterogeneous landscapes (grassland–pasture–wetland connectivity), promote sustainable grazing, and limit harmful agrochemical inputs are therefore important to preserve the foraging opportunities and roosting refuges that cattle egrets (and many associated species) depend upon (Amissah *et al*., 2024; Mesfin *et al*., 2024; Gebrekidan *et al*., 2024).

6. Conclusion

The present study provides valuable insights into the behavioral ecology, activity patterns, and foraging behavior of the cattle egret (*Bubulcus ibis*) in the Chelekleka Wetland, an ecologically significant but under-studied habitat in Ethiopia. The findings indicate that cattle egrets exhibit distinct diurnal activity patterns and seasonal variations in behavior and habitat use. Feeding was the dominant activity observed, particularly during the early morning and late afternoon hours, aligning with peak prey availability and favorable environmental conditions.

The species demonstrated flexible foraging strategies, adapting their behavior to different habitat types and seasonal changes. Insectivorous feeding was predominant, with cattle egrets actively exploiting anthropogenically modified environments such as farmlands, pastures, and areas near livestock confirming their role as effective biological pest control agents. Their high abundance and widespread distribution across habitat types also suggest that the Chelekleka Wetland offers critical resources for feeding, nesting, and roosting.

The study demonstrates that cattle egrets respond dynamically to seasonal changes in habitat and food availability, with implications for their conservation and management. Maintaining grassland habitats, especially in wetland-adjacent areas, is critical to support egret populations. Moreover, future studies could investigate how land-use changes, particularly intensification of agriculture or livestock patterns, may influence egret foraging efficiency and habitat preference

Based on the findings of this study, conservation efforts should prioritize maintaining the hydrological balance of the Chelekleka Wetland throughout the year. This includes protecting inflow channels, reducing sedimentation, and preventing excessive water extraction to ensure the persistence of suitable feeding and roosting habitats for cattle egrets and other

water birds. In addition, agricultural expansion, industrial effluent discharge, and urban encroachment around the wetland should be strictly monitored and regulated. Adoption of sustainable agricultural practices and improved waste management systems is essential to minimize chemical pollution and habitat degradation.

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ORCID

Temesgen Tigab - https://orcid.org/0009-0009-9775-0871

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