Int.J.Curr.Microbiol.App.Sci (2026) *Special Issue-12: 105-121*

International Journal of Current Microbiology and Applied Sciences
ISSN: 2319-7706 **Special Issue-12–Droughts and Floods in the Arid and Semi-Arid Lands**
Journal homepage: http://www.ijcmas.com

https://doi.org/10.20546/ijcmas.2026.sp12.010

Socio-Economic Roles of Birds in Drought Management: A Case of Kyatune-Ikanga Ward in Kitui County, Kenya

Kezia Mbuthia[1] and Moses Mwangi[2]

[1]Department of sociology, Anthropology and Community Development, South Eastern Kenya University
[2]Department of Hydrology and Aquatic Sciences, South Eastern Kenya University

Article Info

Received:
14 April 2026
Accepted:
26 May 2026
Available Online:
10 June 2026

A B S T R A C T

In the Arid and Semi-Arid Lands (ASALs), drought is a serious climate-related threat to livelihoods, food security, and ecological stability. The problem is exacerbated by climate change and population growth pressure. People make use of various knowledge systems to plan and overcome the perils of drought. The technical and policy-based drought management measures have received a lot of attention but have not been well embraced in the rural areas. On the other hand, the importance of biodiversity and traditional ecological knowledge to drought management is reckoned to play a major role in this regard, but it is still not well documented. Cognizance is numerous ecosystem services provided by birds, including monitoring the environment, controlling pests, dispersing seeds, and cycling nutrients. In the Kyatune-Ikanga Ward, Kitui County, Kenya, this study investigated the socioeconomic functions of birds in managing drought. The findings showed that the resident community relies heavily on indigenous ecological knowledge for weather forecasting and drought management. By carefully observing the movements, sounds, and behavioral changes of specific birds, households can predict the onset of rains, anticipate dry spells, and decide on crops and livestock management. While the bird bio-indicators provide early warnings, the community integrates this knowledge with a broader set of traditional practices to manage drought. The study concludes that knowledge on bird behaviours is a vital bio-indicator to anticipate seasons, navigate weather variations, and prepare for potential droughts. The overall recommendation is of active documentation of traditional ecological knowledge alongside conventional meteorology.

Keywords: Livelihoods, variability, climate change, bio-indicators, early warnings.

Introduction

Drought is among the most significant environmental challenges confronting dryland ecosystems globally. Agricultural productivity, biodiversity protection, food security, water availability, and rural livelihoods are all under risk due to the rising frequency, duration, and intensity of drought episodes linked to climate change (Intergovernmental Panel on Climate Change [IPCC], 2023). In arid and semi-arid lands (ASALs), where communities primarily rely on climate-sensitive livelihood systems like rain-fed agriculture, livestock

production, and the use of natural resources, the effects are especially severe (Food and Agriculture Organization [FAO], 2023).

The importance of ecosystem services and biodiversity in enhancing resilience to environmental shocks and climate variability is becoming more widely acknowledged. In order to reduce the risk of disasters and adapt to climate change, nature-based solutions, which use ecosystem functions to address societal issues are being pushed more and more as economical and sustainable methods (United Nations Environment Programme (UNEP), 2022). In this regard, birds are a crucial but frequently disregarded part of ecosystems that greatly enhance human welfare and environmental sustainability.

Numerous ecosystem services that birds offer promote ecological health and agricultural output. Birds have a major role in maintaining ecosystem stability, biodiversity conservation, and food production systems through pest control, seed dispersal, pollination, scavenging, and nutrient cycling (Michel *et al.,* 2020; Mariyappan *et al.,* 2023). According to research, birds have a significant role in controlling insect populations, promoting vegetation regeneration, and aiding in the redistribution of nutrients throughout landscapes (Whelan, Şekercioğlu, & Wenny, 2015). In drought-prone environments, where biodiversity promotes the sustainability and recovery of natural resource systems, these ecological roles become more crucial.

Birds are widely acknowledged as sensitive indicators of environmental change in addition to their ecological responsibilities. Because changes in bird abundance, migration timing, breeding activities, and vocal behavior often reflect changes in habitat quality and climatic conditions, birds are regarded as trustworthy indicators of environmental and climatic change (Hinchcliffe *et al.,* 2025). Birds are therefore widely employed as bioindicators to track environmental disturbances, biodiversity, and ecosystem health. Bird behavior observations have long been integrated into traditional ecological knowledge systems in many rural and indigenous communities to forecast rainfall variability, predict seasonal shifts, and inform agricultural decision-making (Kagunyu *et al.,* 2016).

Traditional ecological knowledge is still used throughout Africa to supplement scientific methods for environmental management and climate forecasting. To predict weather changes and get ready for dry conditions, communities often rely on environmental cues from plants, animals, insects, and birds (Mapfumo *et al.,* 2016). For millennia, farmers have used observations of bird migration, nesting patterns, eating behavior, and vocalization to predict rainfall and direct agricultural operations. Even though these indigenous forecasting techniques are widely used, their contributions to resilience-building and climate adaption are still poorly documented and incorporated into official drought management frameworks.

Arid and Semi-Arid Lands (ASALs) are vital to national livelihoods and food security since they make up more than 80% of Kenya's land area and sustain over 60% of the nation's animal herd (Ministry of Agriculture, Livestock, Fisheries and Cooperatives, 2021). Chronic food insecurity, environmental degradation, and deteriorating household incomes are the results of these regions' frequent droughts, unpredictable rainfall, and growing climate variability (National Drought Management Authority [NDMA], 2024). Due to its mostly semi-arid climate, reliance on rain-fed agriculture, and restricted access to dependable water resources, Kitui County is among the counties most impacted by frequent droughts in Kenya (County Government of Kitui, 2023).

To understand the environmental changes and adjust to climatic instability, communities in Kitui County have traditionally depended on local ecological knowledge (County Government of Kitui, 2023). Birds are essential to this knowledge system because they provide ecological services, food, income, cultural identity, and environmental change indicators.

However, there are very few empirical studies looking at birds' socioeconomic roles in managing drought. The majority of the material currently in publication has concentrated on bird conservation, biodiversity monitoring, and ecosystem services without sufficiently examining the ways in which local communities employ birds to promote resilience and drought adaptation.

Additionally, although many studies have shown the ecological significance of birds, their role in household food security, livelihood diversification, drought forecasting, and ecosystem functioning in ASAL contexts has received less attention. Efforts to include indigenous knowledge systems and biodiversity-based methods into plans for drought adaptation and sustainable development are hampered by this knowledge gap.

Therefore, in Kyatune-Ikanga Ward, Kitui County, Kenya, this study examined the socioeconomic functions of birds in drought management. In particular, the study evaluated birds' contribution to food security and ecosystem functioning, looked at their role as bioindicators of drought and rainfall variability, and analyzed the trade-offs and economic advantages of birds during drought periods.

Research Problem

In Kenya's arid and semi-arid regions, recurrent droughts continue to threaten household livelihoods, food security, agricultural production, and ecological stability. Extended dry spells have worsened resource scarcity, decreased agricultural yields, and made rural households more vulnerable in Kitui County.

Despite the fact that birds are widely acknowledged for offering crucial ecosystem services like pollination support, nutrient cycling, pest control, seed dispersal, and environmental monitoring, their role in drought resilience is still poorly understood and underreported in regional drought management frameworks.

Previous research on birds in Kenya has mostly concentrated on environmental monitoring, species distribution, habitat ecology, and biodiversity protection.

As a result, there are few empirical data on how birds improve food security, support livelihoods, maintain ecosystems, and use native climate forecasting systems to aid in drought adaptation.

Furthermore, modernity, environmental change, and a decline in the intergenerational transmission of indigenous knowledge pose a growing danger to traditional ecological knowledge related to bird behavior.

The integration of biodiversity-based techniques into drought preparedness, climate adaptation, and natural resource management strategies is hampered by the lack of empirical data on the ecological and socioeconomic importance of birds in drought-prone areas.

Evidence of how birds support community resilience during drought times must thus be produced. By investigating the socioeconomic functions of birds in drought management in Kyatune-Ikanga Ward, Kitui County, Kenya, this study sought to fill this gap.

Research Objective

General Objective

To examine the ecological and socioeconomic roles of birds in drought resilience in Kyatune-Ikanga Ward, Kitui County, Kenya.

Specific Objectives

1. To assess the role of birds as bioindicators of drought and rainfall variability.
2. To evaluate the contribution of birds to food security and ecosystem functioning.
3. To examine the economic benefits and trade-offs associated with birds during drought periods.

Significance of the study

This study provides empirical evidence on the role of birds in drought resilience of ASAL communities and contributes to the growing discourse on biodiversity, ecological services, climate adaptation and sustainable development. The results improve our understanding of the contribution of birds to livelihoods in drought-prone areas, food security, ecological functioning and drought forecasting.

The study also emphasizes how crucial traditional ecological knowledge is to environmental management and climate adaption. The study supports continuing attempts to conserve indigenous knowledge and incorporate it into formal frameworks for climate adaptation by recording local knowledge systems pertaining to bird behavior and drought prediction.

From a policy standpoint, county governments, conservation organizations, and development agencies working in ASAL regions may use the findings to guide community resilience interventions, drought preparedness programs, ecosystem-based adaptation projects, and biodiversity conservation strategies.

Research Materials and Methods

Study Area

The study was conducted in Kyatune-Ikanga Ward in Kitui County, Kenya. The ward is located in the Arid and Semi-Arid Lands (ASALs) in Kenya. ASALs are

characterized by low and unpredictable rainfall, high temperatures, frequent droughts and recurring food shortages. Kitui County experiences annual rainfall amounts ranging from 250 mm to 1,050 mm, with most areas exhibiting bimodal rainfall patterns with short rains from October to December and long rains from March to May (County Government of Kitui, 2023).

The local economy is centered on rain-fed agriculture, cattle rearing, charcoal burning, small-scale trading and the exploitation of natural resources. Frequent droughts severely impaired crop production, animal productivity, water availability and household livelihoods making the area suitable for studying the contribution of birds to drought management and community resilience.

Research Design

The study utilized a convergent parallel mixed-method research design. Mixed-methodologies research blends quantitative and qualitative methods in a single study, with the aim of gaining a more comprehensive knowledge of complex phenomena than cannot be achieved by either method alone (Creswell & Clark, 2023). The study's design was appropriate since it quantified community views of birds and explored indigenous knowledge, experiences, and cultural interpretations of drought-related bird behavior.

Quantitative and qualitative data were collected simultaneously, evaluated separately and combined in the interpretation phase to enable triangulation and improve the validity of conclusions.

Study Population

The study was carried out in Kyatune-Ikanga Ward where families were purposively selected to include those who actively participate in farming, livestock keeping and other livelihood activities that were affected by drought. The research also looked at individuals with specific expertise in environmental management, traditional ecological knowledge, agriculture and community leadership.

The population of interest was:

a) Household heads and other adult members of household participating in livelihood activities.
b) Community elders having expertise in traditional ecological knowledge
c) Officers of Agriculture and Environmental departments working in the ward.
d) Community leaders who are conversant with local drought management strategies.

Sampling Procedure and Sample Size

Purposive sampling was used to choose participants with sufficient expertise and experience in drought management and local environmental conditions. According to Nyimbili & Nyimbili, (2024) purposive sampling enables the researcher to choose information-rich cases that can offer useful insights into the issue being investigated. Household respondents were identified based on their residence in Kyatune-Ikanga Ward, their participation in farming and/or animal production, their prior experience with recurrent droughts and their awareness of local environmental conditions. We also used purposeful selection to find key informants with specific skills and experience on community and environmental issues. They were made up of community elders, agricultural and environmental officers and a local administrative head. Sample size. The entire sample size was 42 persons.

Data Collection Method

a) Household Survey Questionnaire

Data were collected quantitatively from household respondents using a standard questionnaire. The questionnaire had closed and open-ended questions to collect data on respondents' demographic characteristics, common bird species in the study area, changes in bird populations during drought periods, use of birds as indicators of rainfall variability and drought, contribution of birds to ecosystem functioning and food security, economic benefits and costs of birds, and community perceptions of bird conservation. The questionnaire was useful in obtaining standardised data that could be used for quantitative analysis.

b) Key Informant interviews

Semi-structured key informant interviews were conducted with people with extensive knowledge of local climatic conditions, drought cycles, biodiversity, agricultural systems and traditional ecological knowledge to get qualitative data. Interviews concentrated on indigenous indicators of drought and rainfall, community

perceptions of bird behaviour, change in bird populations over time, community-based conservation activities, socio-economic advantages connected with birds and variables influencing bird numbers and their habitats. The semi-structured interview method allowed for flexibility in exploring participants' perspectives in depth while preserving uniformity across interviews through the use of a shared interview guide (Adeoye-Olatunde & Olenik, 2021).

c) Validity and Reliability.

The data collection instruments were validated for content validity by subject matter experts in environmental management, sociology and climate adaptation research. Based on their recommendations the instruments were improved in terms of clarity, relevance and alignment with the study objectives. Furthermore, methodological triangulation was employed to enhance the credibility and reliability of the findings through comparison and corroboration of information obtained from household surveys and key informant interviews, a widely used approach to improve trustworthiness in mixed-methods research (Creswell & Clark, 2023).

Data analysis

The quantitative data were coded and placed into the Statistical Package for Social Sciences (SPSS) for analysis. Characteristics of respondents and their views of birds and drought management were described using descriptive statistics (frequencies, percentages, averages, and cross-tabulations). The chi-square test of independence was used to evaluate the relationships between selected demographic factors and respondents' perceptions. Chi-square test is a reasonable method for finding statistically significant correlations between categorical variables (Pallant, 2020). Kendall's tau-b correlation coefficient was used to analyze the connections between ordinal variables on bird activity, drought indicators, ecosystem services, food security, conservation practices and livelihood outcomes. Kendall's tau-b was employed as it is appropriate for ordinal data, small sample sizes and incorporates tied observations (Field, 2018). Statistical significance was accepted at $p < 0.05$.

Thematic analysis was performed on qualitative data from open-ended questionnaire responses and key informant interviews using Braun and Clarke's (2006) technique. The analysis process involved data familiarization, categorization of replies, discovery of repeating patterns, review and refinement of themes and interpretation of findings. Themes included birds as indicators of drought, changes in bird populations, contributions to food security, environmental services, cultural beliefs and behaviours, and economic benefits and trade-offs of birds. Key topics were illustrated by example quotations that helped in understanding of findings.

Ethical Considerations

The study was conducted in accordance with the ethical guidelines of social science research. Before data collection, we informed participants about the study's purpose, that participation was voluntary, that they could withdraw at any moment without penalty, and the measures used to ensure confidentiality and anonymity. All subjects supplied informed consent prior to participation in the trial. Data analysis and reporting were stripped of personal identifiers to protect privacy of participants. The study recognized community knowledge systems by collecting and reporting participants' traditional ecological knowledge in a way that was truthful and respectful. Ethical conduct was based on the internationally accepted principles of respect, beneficence, fairness and respect for communities and cultural knowledge systems (CIOMS, 2016).

Results and Discussion

Demographic data

This section presents the socio-demographic characteristics of respondents, including place of residence, age, gender, education level, duration of residence in the study area, and primary livelihood activities.

The respondents were drawn from the following three areas in Kyatune-Ikanga Ward; Ndatani (27.8%), Kyatune (36.1%) and Mwambani/Vote (36.1%) implying broad representation within the study area. Most of the respondents (80.6%) were aged 41 years and above, while those aged below 41 years were 19.4%. Women were the bulk of respondents (77.8%) while men were 22.2%. Regarding the level of education, more than half of the respondents had a primary education level

(55.6%), 22.2% had a secondary education and only 5.6% had a college or university education. A further 16.7% of respondents indicated no formal education.

The respondents had good experience of living in the study area, of which 55.6% lived for more than 30 years. Another 44.4 percent had resided in the area for fewer than 30 years. With regard to livelihood activities, the most practiced economic activity were farming (38.6%) and livestock keeping (32.5%), followed by trading (25.3%) and others (3.6%). In total, 91.4 percent of the respondents were involved in farming and 77.1 percent in livestock keeping, demonstrating the dominance of agriculture-based livelihoods in the research area.

Table 2 presents a number of chi-square tests to further investigate the demographic patterns found in the research population. Age and duration of residency in the area were significantly correlated (χ^2 (15, N = 36) = 33.53, p =.004), with older participants having stayed in the area for longer periods of time to reinforce their role as custodians of Traditional Ecological Knowledge (TEK). Significant associations with age and education level were found (χ^2 (9, N = 36) = 23.87, p =.005). Younger participants were more likely to have a lower level of formal education compared to older adults. A goodness-of-fit test also indicated a substantial departure from the expected equal distribution of gender, χ^2 (1, N = 36) = 36.00, p <.001, with the majority of the responders being female. It is a sign of rural livelihood dynamics where women are mainly engaged in caregiving and subsistence chores within the household.

Relationship between Birds and Drought in ASALs

a) Types of birds commonly found in Kyatune - Ikanga area

The respondents were asked to name the common bird species in the region. The bird species seen in the three areas prior to, during, and following drought periods are shown in Table 3

Table 3 shows the bird species recognized by the respondents and their perceived importance in the local environment. Respondents related various bird species to drought, rainfall, floods and agricultural productivity.

Examples of bird species that were considered markers of drought were the White Stork (Ciconia ciconia) and the Cattle Egret (Bubulcus ibis) whose presence was known to be associated with extended dry periods. On the other hand the Hamerkop (Scopus umbretta) and the Hadada Ibis (Bostrychia hagedash) were connected with times of plenty of water and flooding. Some birds were reported to signal the coming of rainfall. These included the Barn Swallow (Hirundo rustica), Red-winged Lark (Mirafra hypermetra) and White-browed Coucal (Centropus superciliosus) whose movements, vocalizations and increased activity were recorded before the rainy season. The African Orange-bellied Parrot (Poicephalus rufiventris) was likewise connected with good harvests by the respondents.

In addition to their importance as environmental indicators, the respondents noted other ecological, cultural and livelihood functions of diverse bird species. Some birds were mentioned as food sources, others were associated with pollination, pest regulation, cultural beliefs, warning signs and environmental monitoring. The findings generally demonstrated the presence of a great diversity of bird species in Kyatune-Ikanga which included granivorous, insectivorous, omnivorous and predatory birds that are linked to various ecological and socio-cultural roles in the community.

b) Changes in Bird Population during Drought

The study inquired if respondents had seen changes in the count of birds during dry periods. Thematic analysis revealed several recurring phenomena including reductions in bird population numbers, changes in migratory and migration patterns, changes in habitat use and feeding preferences, increasing concentration around water sources and significant behavioural changes. The respondents claimed some bird species become more mobile during droughts as they search for food and water. Some people said they saw more birds around riverbeds and water, and some species were seen leaving their usual places in the daytime and returning at night.

Respondents reported the following:

"For domestic birds, they become very restless and are not getting full even after feeding, following me all over, that make me know it's going to be hunger'

"Mithonzwe (Village Weaver- Ploceus cucullatus) migrate to where there is food and Ngoso (White-browed Sparrow Weaver-Plocepasser mahali) leaves very early in the morning to look for food near riverbeds'

Table.1 Demographic data

Characteristic	Category	Frequency	Percent
Place of Residence	Ndatani	10	27.8
	Kyatune	13	36.1
	Mwambani/Vote	13	36.1
Age Group	20-30	1	2.8
	31-40	6	16.7
	41-50	11	30.6
	Above 50	18	50.0
Gender	Male	8	22.2
	Female	28	77.8
Education Level	Primary	20	55.6
	Secondary	8	22.2
	Did not go to school	6	16.7
	University/College	2	5.6
Years Lived here	1-10	3	8.3
	11-20	5	13.9
	21-30	5	13.9
	31-40	10	27.8
	41-50	3	8.3
	Above 50	10	27.8
Occupation	Farmer	32	38.6
	Livestock Keeper	27	32.5
	Trader	21	25.3
	Other (Specify)	3	3.6
	Total	83	100.0

Source: Field Data, 2026

Table.2 Chi-square test on demographic patterns

Test	Variables	χ^2	df	p-value
Chi-Square Test of Independence	Age Group × Years Lived in the Area	$\chi^2 = 33.53$	15	.004
Chi-Square Test of Independence	Age Group × Education Level	$\chi^2 = 23.87$	9	.005
Chi-Square Goodness-of-Fit Test	Gender Distribution	$\chi^2 = 36.00$	1	<.001

Source: Field data, 2025

Table.3 Distribution of birds in the Kyatune-Ikanga area

	Name of the bird			Uses of the bird			
	Kikamba	**English**	***Botanical***	**During drought**	**During floods**	**Weather forecast**	**Other uses**
1	Ndundu	Verreaux's Eagle Owl	*Bubo lacteus*	N/A	N/A	N/A	Its sound near the homestead indicates bad omen
2	Muthoonzwe	Village Weaver	*Ploceus cucullatus*	food	food	✓	N/A
3	Ingwaa	Hadad ibis	*Bostrychia Hagedash*	N/A	It indicates the presence of much water	N/A	N/A
4	Kasevela	Variable Sunbird	*Cinnyris venustus*	food	food	N/A	Used in cross pollination as it depends on nectar
5	Ngwai	African Orange-bellied Parrot	*Poicephalus rufiventris*	N/A	It indicates the plenty of harvest	✓	N/A
6	Ngilikili	Nubian Woodpecker	*Campethera nubica*	N/A	N/A	N/A	It indicates the presence of a stranger
7	Ndiu	Augur Buzzard	*Buteo augur*	N/A	N/A	✓	
8	Ngunguu	Pied Crow	*Corvus albus*	N/A	N/A	N/A	It indicates slaughter zone
9	Kindilima	Common Quail	*Coturnix coturnix*	food	It indicates the presence of green pasture	✓	
10	Nganga	Helmeted Guineafowl	*Numida meleagris*	food	food	N/A	Their feathers are used for decoration purposes
11	Ikooto	African Grey Hornbill	*Tockus nasutus*	food	food	N/A	It is known as a complaining bird in the wild
12	Kilui	Eastern Chanting Goshawk	*Melierax poliopterus*	N/A	N/A	N/A	Symbolizes vision and speed
13	Ndei	White-backed Vulture	*Gyps africanus*	N/A	N/A	N/A	Indicates death calamity of animals
14	Katalatwa	African Goshawk	*Accipiter tachiro*	N/A	N/A	N/A	Depends on other birds, helps farmers in chasing away birds which depends on grains during harvesting period
15	Ivui	Red-eyed Dove	*Streptopelia semitorquata*	food	food	N/A	It indicates peace and humility
16	Mbaa	Yellow-necked Spurfowl	*Francolinus leucoscepus*	food	Food	N/A	Bamba harvest
17	Kanange	Cattle Egret	*Bubulcus ibis*	N/A	N/A	N/A	Indicate severe drought

18	Nguni	Hamerkop	*Scopus umbretta*	N/A	N/A	✓	It indicates much water
19	Inwyii	Speckled Mousebird	*Colius striatus*	food	food	N/A	Spirit of delay
20	Kamunee	Grey-backed Camaroptera	*Camaroptera brachyura*	food	food	N/A	Produces sounds to indicate danger
21	Nzungululu	Barn Swallow	*Hirundo rustica*	N/A	N/A	✓	Shows the onset of the rain
22	Kalumalumi	Red-winged Lark	*Mirafra hypermetra*	food	food	✓	Shows the onset of the rain
23	Itulukui	Common Bulbul	*Pycnonotus barbatus*	food	food	N/A	
24	Mututu	D'Arnaud's Barbet	*Trachyphonus darnaudii*	food	food	N/A	Symbolizes foolishness
25	Ngoso	White-browed Sparrow Weaver	*Plocepasser mahali*	food	food	N/A	Its sound is used to wake people early in the morning.
26	Kasilili	Red-cheeked Cordon-bleu	*Uraeginthus bengalus*	food	food	N/A	Believed to be a teacher of other birds
27	Kindili	Crested Francolin	*Francolinus sephaena*	food	food	N/A	
28	Ndumbu	Emerald-spotted Wood Dove	*Turtur chalcospilos*	food	food	N/A	Indicates meekness
29	Isoia	Superb Starling	*Lamprotornis superbus*	food	food	N/A	Its feathers are used for decorations. eg. during music festivals
30	Katulanga mityothoka	Grey Wren Warbler	*Calamonstes simplex*	food	food	N/A	Indicates danger by making noise after seeing a dangerous animal
31	Nthuu	Blue-naped Mousebird	*Urocolius macrourus*	food	food	N/A	
32	Maseu	White Stork	*Ciconia ciconia*	N/A	N/A	✓	Once seen indicates strike of a severe drought
33	Katetee	Rattling Cisticola	*Cisticola chiniana*	food	food	N/A	Makes noise after seeing a dangerous animal eg. snake
34	Ituvatuvilya	White-browed Coucal	*Centropus superciliosus*	N/A	N/A	✓	It produces sound to announce that rain is coming soon
35	Iloloi	Zanzibar Greenbul	*Andropadus importunus*	Food	food	N/A	N/A
36	Ngumbuakyende	Pygmy Falcon	*Polihierax semitorquatus*	N/A	N/A	N/A	Depends on other birds thus reducing them from the ecosystem
37	Ikuku	Slate-coloured Boubou	*Laniarius funebris*	N/A	N/A	N/A	Used by witch crafts to deliver a certain message
38	Yoowe	Donaldson Smith's Nightjar	*Caprimulgus donaldsoni*	N/A	N/A	N/A	Symbolizes laziness
39	Nziui	Red-billed Oxpecker	*Buphagus erythrorhynchus*	N/A	N/A	N/A	Act as natural remover
40	Mavaata ma kiw'uni	Egyptian Goose	*Alopochen aegyptiaca*	food	food	N/A	Indicates Purity, love and transformation

Source: Field Data, 2025

"We see them move away in the morning looking for food and they come back in the evening"

The respondents also reported that drought periods coincided with declines in the abundance of many bird species, especially doves and weaver birds. Changes in feeding behaviour were also seen with birds increasingly using other sources of food and becoming more apparent around homesteads and water points.

Changes in behaviour such as the restlessness of household birds were regularly cited as indicators of worsening drought conditions.

c) Birds as Indicators of Dry and Wet Season

Thematic analysis of the respondents' opinions on birds as indicators of drought and rainfall resulted in a number of recurring themes including changes in bird movements, increased presence near water sources, changes in vocalisation, altered feeding behaviours, appearance of specific species of bird and disappearance of others. Respondents linked particular bird species and behaviours to the arrival of drought or rain. Indications typically highlighted were changes in bird cries, group movements, feeding patterns and the presence or absence of certain bird species.

Some of the responses said:

"Farm chicken are very glutonous which show drought"

*"Ingwaa (*Hadad ibis-*Bostrychia Hagedash) sing songs and during drought you can hear those sounds"*

*"Seeing Ikuku (*Slate-coloured Boubou-*Laniarius funebris) indicate plenty of rains"*

"Ituvatuvilya (White-browed Coucal-*Centropus superciliosus) indicate rain and is interestingly very noisy"*

*"When it is about to rain birds like Kathililya/Nzungululu (*Barn Swallow-*Hirundo rustica) move about in groups"*

"Kanililia come to tell rain season is coming in October or November"

*"When Ivui (*Red-eyed Dove-*Streptopelia semitorquata) roars, within a week, we see rainfall"*

"Mavui (dove) change sound to tell there is rain or its near"

Respondents noted that the quantity of birds around rivers and drinking spots was frequently associated with drought conditions. The commencement of rain was often connected with large-scale movements of species like Barn Swallows, Guinea Fowls, Weaver Birds etc. They also reported wide shifts in vocalization, with the Hadada Ibis being more vocal before the rain starts. Respondents also reported that the absence of some species such as the Village Weaver (Ploceus cucullatus) was often taken as a sign of drought whereas the presence of species such as the Slate-coloured Boubou (Laniarius funebris) and Red-eyed Dove (Streptopelia semitorquata) was associated with impending rain.

Respondents also observed changes in nesting and breeding activity during dry periods. These included reduced nest construction, fewer breeding birds, more deserted nests, and birds relocating to areas where more food, water and shelter would be available.

Birds and Food Security in Drought

a) Pest and seed dissemination management

Thematic analysis identified several recurring themes relating to the importance of birds for food security and ecosystem functioning. These were insect control, seasonal feeding patterns, conflicts with farmers, seed dissemination, soil fertility enhancement, regeneration of cow pasture and regeneration of vegetation.

The respondents claimed birds eat insects, worms and caterpillars that affect crops and help to eliminate pests. However, other participants stated that several bird species also graze on fields notably when crops are ripe.

The views of the respondents are reflected in the following extracts:

"We noted during Mbaazi (Pigeon Peas) season birds eating worms"

"Manyilu eat worms and you don't have to buy pesticides"

"Remove worms but also costly because they eat green grams"

*"Ivoi/Katumbo (*Red-eyed Dove*), if we find them dead, we know our farm chicken will get sick between May and August. If these birds don't die, we know our chicken will survive"*

Respondents also stated that birds had an important role in seed dispersal and soil enrichment.

The majority of respondents (83.3%) reported that birds disperse seeds of watermelon, millet, grasses and wild tomatoes on farms and grazing lands.

The following statements were often made:

"Birds bring mwelelu (Kikuyu grass-Cenchrus clandestinus) grass seeds which is loved by cattle ensuring the seed doesn't come to an end"

"Grass hooks itself on their legs and their droppings bring tomatoes and grass"

"Water melon, they just appear on our shambas if we haven't planted, some mature and we enjoy eating them"

Respondents also reported that bird droppings increased soil fertility and pasture regeneration, and that seed distribution helped in the establishment of grasses and other plants for animal feed and domestic consumption.

b) Birds as a potential alternative food source for households and livestock

Thematic analysis showed a number of themes related to the consumption of birds as alternative food sources in times of drought. These included hunting and trapping techniques, collection of bird eggs, traditional means of bird preparation, preferred bird species for eating and perceived contributions of birds to availability of cattle fodder.

Most of the respondents (72.2%) reported that they and their families have eaten birds or bird products during drought periods.

The following passages show the diversity of gathering and preparation processes reported by respondents for birds for consumption:

"We break their nests and take the birds and eat. Since they are many small ones, we put them in a basin of water and clean them, then we boil and eat"

"The eggs are very small we would just boil it together with the birds after burning the feathers and removing the intestines"

Respondents listed several bird species that were commonly consumed during times of food shortage but some were thought to be difficult to trap or shoot.

There was disagreement about the importance of birds in the supply of cattle fodder. Moreover 52.8% of the respondents believed that birds are a source of cattle food, whereas 47.2% did not.

Some responses mentioned that birds indirectly benefit livestock through seed dispersal and nest materials:

"Ngoso (White-browed Sparrow Weave-Plocepasser mahali) builds nests during the wet season and abandon them during the dry seasons. Those nests are made of grass which we gather for livestock when drought is severe"

*"During drought, there is no food for domestic animals. Cats eat birds while dogs catch Nganga (*Helmeted Guineafowl*) from the farms and eat "*

"Droppings from birds keep bringing varieties of grass you don't normally see"

The responders pointed out that bird activities lead to the establishment and regeneration of grasses needed by livestock notably during periods of environmental stress.

c) Birds and traditional or cultural practices related to food security

Respondents reported a variety of measures used to conserve birds and to manage bird interactions. Common themes were non-lethal bird deterrent methods, habitat conservation, restriction of shooting, pesticide use and community conservation projects. Some respondents stated they employed traditional methods to scare birds away from crops instead of killing them. Some examples of responses included:

Instead of killing them, we use traditional methods where we tie pieces of mabati (iron sheet) to make noise.

Government doesn't allow hunting birds, they should have a sanctuary to keep them because we must hunt them for food and to protect our farms

The pesticide we use kills birds, it's best to trap them

*We normally put insecticide/pesticide in food and mix in a bowl, we then drop them in the farm, the birds eat and die. When Nganga (*Helmeted Guineafowl) *and Mbaa (*Yellow-necked Spurfowl*) eat and die, it's not good because they are edible*

There was a diversity of views about birds among the respondents. Many praised the ecological and livelihood benefits while others perceived some bird species as crop pests or as a source of losses to agricultural productivity. Thematic analysis also highlighted traditional beliefs and cultural practices that linked birds with food security and agricultural management. Attempts to influence bird migrations and secure crops included rituals, hymns, taboos and local practices.

The following statements illustrate these practices:

"Village elders would gather and sing and chant all night and early in the morning, they would tell the birds consuming their crops to leave the farms and never come back. They would use a catapult directing the birds on the direction to go and move until they were out of the village, the birds would move as instructed"

*"No matter how hungry you are, you can't eat Kilui (*Eastern Chanting Goshawk-*Melierax poliopterus) and Ndei (*White-backed Vulture-*Gyps africanus) because they eat snakes which has poison, so their blood in return is poisonous"*

Respondents said that the presence/absence of some bird species influenced their agricultural decisions and seasonal planning. They also noted cultural constraints in the usage of some bird species, due to past community views and actions.

Economic costs and advantages of birds in drought

a) Birds and their contribution to farm productivity

Thematic analysis indicated a variety of perspectives regarding the role of birds in farm output. The primary issues that emerged were Insect management, Crop damage, Soil aeration, Soil fertility improvement and Income generation from Bird related activities. Respondents reported birds ate insects, worms and other pests of the crop. However, numerous respondents also mentioned that some bird species fed on fields causing agricultural loss. Views of the respondents are as follows:

"They eat the pests as food"

"They don't contribute; they eat our crop which neutralizes their usefulness of eating worms"

"Scratching the soil surface leading to aeration"

"Mbiwa piles stool that is manure"

Some respondents claimed beneficial effects of birds on agricultural productivity. 61.1% of respondents reported that birds did not offer rapid benefits to their farms because of damage to crops due to feeding activities.

Respondents also mentioned the contribution of birds to soil fertility through their droppings, nest materials and activities that disturbed or loosened the soil surface.

Better soil conditions were often associated with bird droppings, and decomposing nests added organic materials to the soil.

They also reported economic benefits from domestic and wild birds, in addition to ecological roles.

During droughts, some interviewees said they sold birds or bird products to supplement household income.

The following selections exemplify these views:

*"We sell and use the proceeds to buy food e.g. Nganga (*Helmeted Guineafowl*)"*

"Chicken is our fall-back plan but not wild birds, who will hunt them"

*"Some farmers trap and catch Nganga (*Helmeted Guineafowl*), but we have told them it is illegal and if caught will be arrested, they still catch them but few people" Farmer agricultural officer*

Poultry rearing was noted as a source of food and income in dry periods. Some responders also mentioned that wild birds such Helmeted Guineafowl (Numida meleagris) were trapped and sold however doubts were raised on the legality of such operations.

Table.4 Variables with moderate and strong correlations.

Variables	Correlation Coefficient (Kendall's tau_b)	Significance (p-value)
Bird activity & Soil fertility benefits	0.500	0.003
Birds & Ecosystem balance	0.533	0.002
Birds & Drought management practices	0.354	0.036
Habitat reduction & Farming/Drought resilience	0.395	0.019
Bird consumption & Food availability for livestock	0.656	0.000
Birds as pest controllers & Bird consumption	0.614	0.000
Bird-based early warning system & Nesting/Breeding changes	0.604	0.000
Birds as drought indicators & Nesting/Breeding changes	0.366	0.031

Source: Field Data, 2025

b) Correlation analysis

A Kendall's tau-b correlation analysis was conducted to examine correlations between bird related parameters, ecosystem services, drought management measures and food security outcomes. The significant correlations identified in this investigation are presented in Table 4.

Bird activity was positively associated to perceived benefits of soil fertility (τb = 0.500, p = 0.003) and ecological balance (τb = 0.533, p = 0.002). We also observed a high positive association (τb = 0.354, p = 0.036) between bird activity and drought management techniques. Habitat degradation was strongly linked with farming and drought resilience results (τb = 0.395, p = 0.019). Bird intake was positively correlated with food availability for livestock (τb = 0.656, $p < 0.001$) and with attitudes of birds as controllers of pests (τb = 0.614, $p <$ 0.001). Bird-based early warning systems were positively linked to nesting and breeding changes (τb = 0.604, $p <$ 0.001). Likewise, perceptions of birds as drought indicators were significantly associated with change in nesting and breeding (τb = 0.366, p = 0.031).

Birds as Bio indicators of Drought and Rainfall Variability

According to this study, local communities in Kyatune-Ikanga Ward regard birds as significant indicators of rainfall variability and drought. Respondents linked approaching droughts or rainy events to alterations in bird movement patterns, vocalizations, feeding behavior, nesting activities, and species abundance. Indicators of seasonal weather shifts were often seen in species including the Red-eyed Dove (Streptopelia semitorquata), Hadada Ibis (Bostrychia hagedash), White-browed Coucal (Centropus superciliosus), and Barn Swallow (Hirundo rustica). The results show that traditional ecological knowledge (TEK) is still relevant in ASAL communities for climate adaptation and environmental monitoring.

Reduced presence, increased migration, concentration around water sources, and altered feeding behaviors are among the observed changes in bird populations during drought periods. These findings are in line with earlier research demonstrating that birds react quickly to environmental stress and shifting climatic conditions (Hinchcliffe, & Tkaczynski, (2025); Kumar *et al.,* 2024). Because their range, nesting habits, and behavioral reactions frequently reflect ecosystem changes before such changes become apparent in other ecological components, birds are widely acknowledged as useful bioindicators (Hinchcliffe *et al.,* 2025)

Additionally, respondents stated that periods of dryness were linked to a decrease in nesting and breeding activity, an increase in nest abandonment, and bird migration to regions with more food and water. Studies showing that extended droughts have a detrimental impact on bird reproduction due to decreased food availability, dehydration stress, and habitat destruction have shown similar findings (Conradie *et al.,* 2020; Zhang *et al.,* 2024).

These results imply that local bird behavior observations could offer useful additional data for environmental monitoring and drought forecasts.

Birds are important indicators of environmental change, as evidenced by the substantial correlation (τb = 0.604, p < 0.001) between bird-based early warning systems and changes in nesting and breeding behavior. Similarly, communities actively interpret bird behavior as part of local forecasting systems, as evidenced by the positive correlation between observed nesting changes and views of birds as drought indicators (τb = 0.366, p = 0.031). Drought readiness and climate adaption efforts in drought-prone areas may be strengthened by incorporating such indigenous forecasting indicators into official early warning systems.

Contribution of Birds to Food Security and Ecosystem Functioning

The results showed that by controlling pests, dispersing seeds, improving soil fertility, regenerating pastures, and providing other food sources during dry spells, birds considerably contribute to food security and ecosystem functioning. According to respondents, birds lessen the pest pressure on farms by eating insects, worms, and caterpillars that harm crops. These results corroborate other research (Whelan, Şekercioğlu, & Wenny, 2015; Lindell *et al.,* 2018) that found birds to be significant providers of biological pest management services in agricultural systems.

The study did, however, also show that there is a complicated relationship between birds and agricultural output. Although birds help control pests, several species have been known to harm crops, especially when they are maturing. Similar trade-offs have been shown in agricultural settings where birds both contribute to ecosystem services and cause financial losses by stealing crops (Zhang *et al.,* 2024). The results thus emphasize the necessity of management strategies that strike a compromise between the requirements of farmers and conservation goals.

Another significant ecological role that birds play is seed dispersion. According to the respondents, birds spread the seeds of several plant species over farms and grazing areas, including millet, watermelon, wild tomatoes, and grasses. Additionally, pasture vegetation renewal and soil enrichment were linked to bird droppings. These findings are in line with earlier studies that show how important birds are for maintaining biodiversity, regenerating vegetation, and recovering ecosystems through seed distribution mechanisms (González-Varo, 2025; Zhang *et al.,* 2024).

Bird activity and perceived benefits to soil fertility are strongly positively correlated (τb = 0.500, p = 0.003), indicating that local populations are aware of the role birds play in preserving productive agricultural landscapes. The favorable correlation between birds and ecosystem balance (τb = 0.533, p = 0.002) further suggests that birds' ecological roles are well acknowledged. Studies that demonstrate how birds enhance ecological stability through seed distribution, pollination-related services, nutrient cycling, and pest management (Whelan, Wenny, & Marquis, 2015; Mariyappan *et al.,* 2023) bolster these conclusions. The study also discovered that during dry spells, birds act as substitute food sources. During times of food scarcity, almost two-thirds of respondents said they consumed birds or bird products. When traditional food supplies were scarce, wild birds and bird eggs were found to be additional food sources. Similar results have been documented in rural areas where wild birds support household food security during times of resource constraint and climate shocks (Fremout *et al.,* 2022).

A further indication of the interdependence of birds, livestock production, and food security is the positive correlation (τb = 0.656, p < 0.001) between bird intake and animal food availability. According to respondents, birds helped regenerate pastures by dispersing seeds, and during extreme droughts, abandoned nests sometimes served as fodder. These results imply that birds help agricultural and animal production systems through ecological services that both directly and indirectly contribute to food security.

Economic Benefits and Trade-Offs Associated with Birds During Drought

The study found that having birds during dry spells had both financial advantages and disadvantages. According to the respondents, raising poultry, selling domestic birds, and occasionally trading wild birds were significant livelihood choices that improved household resilience and produced income. Chickens were frequently seen as a "fall-back" asset that could be sold for money or eaten to meet household nutritional needs during times of food scarcity. Indigenous chicken production improves household resilience, food security, and livelihood diversification among rural populations exposed to frequent drought and climate-related shocks, according to recent studies (Dione *et al.,* 2025; Manzvera *et al.,* 2023).

Respondents also mentioned financial costs related to crop damage brought on by some bird species. Birds helped manage pests, but some species were thought to cause significant losses by eating grains and other crops. As a result, most respondents focused on the obvious financial consequences of crop damage rather than the immediate farm-level advantages of birds. Studies looking at human-wildlife interactions in farming systems have shown similar conflicts between conservation and agricultural output (Lindell *et al.,* 2018).

The study also found conservation issues related to the commercial use of birds. Although some respondents acknowledged the significance of birds for ecosystem health and food security, others described using unlawful harvesting, poisoning, and trapping methods to manage bird populations or gain food. The reported capture and sale of Helmeted Guineafowl (Numida meleagris) serves as an example of the conflicts that may occur between household survival tactics during dry spells and biodiversity conservation goals. Similar difficulties have been reported in numerous rural settings where wildlife protection laws may clash with economic necessities.

The multiple and sometimes contradictory roles that birds play within local livelihood systems are highlighted by the positive correlation ($\tau b = 0.614$, $p < 0.001$) between bird consumption and perceptions of birds as pest controls. Birds were perceived as competitors for agricultural resources, sources of food, and providers of ecological services.

The need for coordinated conservation strategies that acknowledge the ecological and socioeconomic significance of birds within ASAL communities is highlighted by this contradiction.

The results also showed that, in spite of the difficulties brought on by agricultural loss, there is strong community support for bird conservation. Indigenous techniques for safeguarding crops without killing birds, cultural prohibitions on harvesting specific bird species, and the usage of noise-making equipment were among the customs mentioned by respondents.

These findings show that local conservation efforts are still crucial to preserving bird populations and the environmental services they provide. Ecological sustainability and community resilience may be improved by incorporating such indigenous conservation techniques into larger biodiversity management and climate adaptation initiatives.

Overall, the study shows that birds promote livelihoods, improve food security, monitor the environment, and function in ecosystems, all of which contribute to drought resistance.

The results corroborate mounting evidence that drought adaptation and resilience-building initiatives in ASAL regions should incorporate traditional ecological knowledge and biodiversity conservation.

Conclusion and Recommendations

Conclusion

This study examined the socio-economic roles of birds in drought management in Kyatune-Ikanga Ward, Kitui County, Kenya. The results show that birds are significant bioindicators of rainfall variability and drought in nearby communities. In order to predict environmental changes and seasonal weather patterns, respondents relied on variations in bird movement, vocalization, feeding behavior, nesting activities, and species abundance. These findings demonstrate the ongoing use of traditional ecological knowledge in predicting and preparing for drought. The study also found that birds have a major role in ecosystem functioning and food security. Birds contribute to agricultural productivity and ecosystem stability by controlling pests, dispersing seeds, improving soil fertility, and regenerating pastures. Some households use birds and bird products as additional food sources during times of food scarcity, which increases household resilience during droughts. The results also showed that birds present both opportunities and difficulties for the economy. While some bird species have been known to cause agricultural damage and resource competition, poultry rearing and the sale of bird products contribute to household income and livelihood diversification. Despite these difficulties, most communities acknowledged the ecological and socioeconomic significance of birds and backed conservation initiatives meant to preserve bird populations and the ecosystem services they provide. Overall, the study shows that birds promote livelihoods, improve food security, monitor the environment, and provide ecosystem services, all of which contribute to drought resistance. The results highlight the necessity of incorporating ecosystem-based approaches, biodiversity protection, and bird-based traditional ecological

knowledge into drought management and climate adaption plans in Kenya's ASAL regions.

Recommendations

Based on the findings of the study, several recommendations are proposed. First, bird-based traditional ecological knowledge should be integrated into community-level drought monitoring and early warning systems. Collaboration between local communities, meteorological agencies, and the National Drought Management Authority (NDMA) could strengthen drought preparedness by incorporating indigenous environmental indicators into existing forecasting frameworks. Second, county governments and conservation agencies should promote bird-friendly agricultural practices such as agroforestry, habitat restoration, and reduced reliance on harmful pesticides.

These interventions would help conserve bird populations while enhancing ecosystem services related to pest control, seed dispersal, and soil fertility. Third, community awareness programmes should be implemented to improve understanding of the ecological and economic importance of birds. Such programmes could encourage sustainable utilization of bird resources while reducing destructive practices such as poisoning and illegal harvesting. Fourthly, further research should be undertaken to quantify the contribution of birds to agricultural productivity, ecosystem resilience, and drought adaptation across different ASAL ecosystems.

Longitudinal studies would be particularly valuable in assessing changes in bird populations and their implications for climate adaptation over time.

Acknowledgements

The authors wish to thank the residents of Kyatune-Ikanga Ward for their willingness to participate in this study and for generously sharing their knowledge and experiences regarding birds and drought management. Appreciation is also extended to local leaders, agricultural officers, and community elders who provided valuable information during the data collection process. The authors further acknowledge South Eastern Kenya University for providing institutional support during the study. Special gratitude is extended to perfect STORM Project who contributed to the successful completion of the research.

Conflict of Interest

The authors declare no competing interests.

References

Adeoye-Olatunde, O. A., & Olenik, N. L. (2021). Research and scholarly methods: Semi-structured interviews. Journal of the American College of Clinical Pharmacy, 4(10), 1358–1367.

Braun, V., & Clarke, V. (2021). Thematic analysis: A practical guide. Sage Publications.

Conradie, S. R., Woodborne, S. M., Wolf, B. O., Pessato, A., Mariette, M. M., & McKechnie, A. E. (2020). Avian mortality risk during heat waves will increase greatly in arid Australia during the 21st century. Conservation Physiology, 8(1), coaa048.

Copernicus Climate Change Service. (n.d.). Bird migration. European Centre for Medium-Range Weather Forecasts. Retrieved June 11, 2026, from https://climate.copernicus.eu/bird-migration

Council for International Organizations of Medical Sciences. (2016). International ethical guidelines for health-related research involving humans: Prepared by the Council for International Organizations of Medical Sciences (CIOMS) in collaboration with the World Health Organization (WHO). Council for International Organizations of Medical Sciences. https://cioms.ch/wp-content/uploads/2017/01/WEB-CIOMS-EthicalGuidelines.pdf

County Government of Kitui. (2023). Kitui County Integrated Development Plan (CIDP) 2023–2027. County Government of Kitui. https://repository.kippra.or.ke/items/4d597f56-acbb-4476-8852-31adee0a4d33

Creswell, J. W., & Plano Clark, V. L. (2023). Revisiting mixed methods research designs twenty years later. In Handbook of mixed methods research designs (pp. 21–36).

Dione, M., Ilboudo, G., Ouedraogo, B., Ima, S. A., Kagambèga, A., Ganser, C., Boz, Z., Knight-Jones, T., & Alders, R. (2025). Village chickens can strengthen community resilience in the face of insecurity and climate change in Burkina Faso. In Proceedings of the 1st World Native Poultry Conference (Bangkok, Thailand, March 12, 2025). World Poultry Science Association.

Food and Agriculture Organization of the United Nations. (2023). The impact of disasters on agriculture and food security 2023: Avoiding and reducing losses through investment in resilience. FAO. https://doi.org/10.4060/cc7900en

Field, A. (2024). Discovering statistics using IBM SPSS statistics (6th ed.). Sage Publications.

Fremout, T., Thomas, E., Taedoumg, H., Briers, S., Gutiérrez-Miranda, C. E., Alcázar-Caicedo, C.,... Muys, B. (2022). Diversity for restoration (D4R): Guiding the selection of tree species and seed sources for climate-resilient restoration of tropical forest landscapes. Journal of Applied Ecology, 59(3), 664–679.

González-Varo, J. P. (2025). Avian seed dispersal out of the forests: A view through the lens of Pleistocene landscapes. Journal of Ecology, 113(3), 510–517.

Hinchcliffe, D. L., & Tkaczynski, P. (2025). Shifting seasons: Long-term insights into climate change effects on bird phenology from ringing data. Ecology and Evolution, 15(10), e72317.

Intergovernmental Panel on Climate Change. (2023). Climate change 2023: Synthesis report. Contribution of Working Groups I, II and III to the Sixth Assessment Report of the Intergovernmental Panel on Climate Change (H. Lee & J. Romero, Eds.). IPCC. https://doi.org/10.59327/IPCC/AR6-9789291691647

Kagunyu, A., Wandibba, S., & Wanjohi, J. G. (2016). The use of indigenous climate forecasting methods by the pastoralists of Northern Kenya. Pastoralism, 6(1), 7.

Kumar, S., Kler, T. K., Sekhon, G. S., & Sahni, T. (2024). Impacts on avian migratory patterns due to climate change and hormonal disruption: A review. Mitigation and Adaptation Strategies for Global Change, 29(7), 69.

Lindell, C., Eaton, R. A., Howard, P. H., Roels, S. M., & Shave, M. E. (2018). Enhancing agricultural landscapes to increase crop pest reduction by vertebrates. Agriculture, Ecosystems & Environment, 257, 1–11.

Manzvera, J., Mutandwa, E., Katema, T., Stack, J., & Tirivanhu, D. (2023). Indigenous chicken market participation and smallholder farmers' well-being outcomes in Chiredzi and Mwenezi Districts of Zimbabwe. Journal of Agriculture and Environment for International Development, 117(1), 5–20.

Mapfumo, P., Mtambanengwe, F., & Chikowo, R. (2016). Building on indigenous knowledge to strengthen the capacity of smallholder farming communities to adapt to climate change and variability in Southern Africa. Climate and Development, 8(1), 72–82.

Mariyappan, M., Rajendran, M., Velu, S., Johnson, A. D., Dinesh, G. K., Solaimuthu, K., & Sankar, M. (2023). Ecological role and ecosystem services of birds: A review. International Journal of Environment and Climate Change, 13(6), 76–87.

Michel, N. L., Whelan, C. J., & Verutes, G. M. (2020). Ecosystem services provided by Neotropical birds. The Condor, 122(3), duaa022.

Ministry of Agriculture, Livestock, Fisheries and Cooperatives. (2021). Agricultural policy 2021. Government of Kenya. https://kilimo.go.ke/wp-content/uploads/2024/10/Agricultural-Policy-2021.pdf

National Drought Management Authority. (2024, May). National drought early warning bulletin: May 2024. Government of Kenya. https://ndma.go.ke/case-studies/national-drought-early-warning-bulletin-may-2024/

Nyimbili, F., & Nyimbili, L. (2024). Types of purposive sampling techniques with their examples and application in qualitative research studies.

Pallant, J. (2020). SPSS survival manual: A step-by-step guide to data analysis using IBM SPSS (7th ed.). Routledge.

Taherdoost, H. (2016). Validity and reliability of the research instrument: How to test the validation of a questionnaire/survey in a research. International Journal of Academic Research in Management, 5, 28–36.

United Nations Environment Programme. (2022). Global environment outlook 6: Healthy planet, healthy people. UNEP. https://www.unep.org/resources/global-environment-outlook-6

Whelan, C. J., Şekercioğlu, Ç. H., & Wenny, D. G. (2015). Why birds matter: From economic ornithology to ecosystem services. Journal of Ornithology, 156(Suppl. 1), 227–238.

Whelan, C. J., Wenny, D. G., & Marquis, R. J. (2008). Ecosystem services provided by birds. Annals of the New York Academy of Sciences, 1134(1), 25–60.

Zhang, L. B., Ma, Z., & Liu, Y. (2024). Biological traits and biome feature mediate responses of terrestrial bird demography to droughts. Journal of Animal Ecology, 93(12), 1868–1880.

How to cite this article:

Mbuthia, K. and Mwangi, M. (2026). Socio-Economic Roles of Birds in Drought Management: A Case of Kyatune-Ikanga Ward in Kitui County, Kenya. *Int.J.Curr.Microbiol.App.Sci.* Special Issue-12: 105-121.
doi: https://doi.org/10.20546/ijcmas.2026.sp12.010