Natural enemies in the management of Red-billed quelea (Quelea quelea) in Hadejia-Nguru wetlands, Nigeria: A conservation-based review

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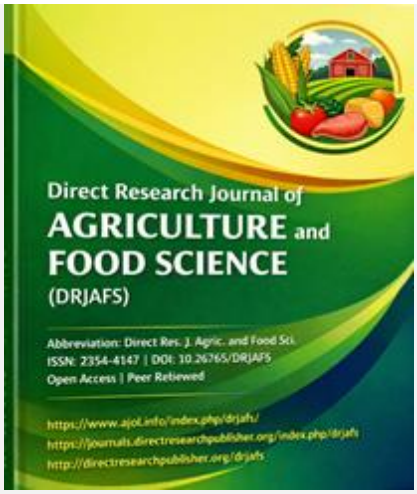
ABSTRACT

Rice is one of the major cereal crops in the world that has the potential to significantly contribute to the achievement of global food security. Animal pests cause about 15% of the world's rice output to be lost. The most dangerous pest birds are migratory, gregarious birds like the Red-billed Quelea (Quelea quelea), a nomadic pest of cereal crops that feeds in large flocks. In Nigeria's Hadejia-Nguru marshes. The aim of this review is to explore the possibility of using natural enemies to manage the population of this pest bird. A systematic literature review of journals and articles covering from 2015 to 2026 using Data bases such as PubMed, Science direct and google scholar were assessed. The keywords Conservation, control, Raptors, Quelea quelea, and wetlands, were used in literature search. Findings reveals that one of the causes of the bird's abundance is the expansion of grain production, especially rice, in the region and nearby communities. The use of the organophosphate substance Fenthion (Qualithox), which has numerous drawbacks, is one of the main methods of controlling the pest bird. The potential use of birds' natural enemies to manage the species was emphasized in this paper. The numerous uses of natural enemies, especially birds of prey, were well reviewed in the literature. The main issues include sluggish reproduction of the raptors, anthropogenic activities including hunting, habitat loss, electrocution, and secondary poisoning, which are causing the population of birds of prey to severely decline. This review proposes the use of conservation of the raptors as a strategy. This implies that it is possible to reintroduce the Queleas natural enemies, which are birds of prey. This can be accomplished by providing nesting boxes, avoiding the use of chemicals, controlling trade-offs like the use of certain birds and their parts for medicine and rituals, implementing agroforestry, massive afforestation, regulating hunting, and using wetland resources unsustainably.

Keywords: *Conservation, Control, Raptors, Quelea quelea, and wetlands*



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INTRODUCTION

One of the main goals of farmers and the government of every country is to achieve food security and self-sufficiency in food production. The ability to provide humans with enough food, both in terms of quantity and quality, to support a productive and healthy life is referred to as food security (Amodu, 2023). One of the major cereal crops in the world, rice has the potential to significantly contribute to the achievement of global food

security. Animal pests (arthropods, nematodes, rodents, birds, slugs, and snails) cause about 15% of the world's rice crop to be lost. The most dangerous pest birds are migratory, gregarious species like Red-billed Quelea, but there are also local varieties like water birds (Mey, 2013). The loss of biodiversity is largely caused by changes in land use and habitat, mainly as a result of growing human populations and food demand (Pringle, 2022). Agrochemicals are among the most prevalent contaminants in one-fifth of the world's land due to their enormous market on every continent. Additionally, the detrimental effects of most insecticides, herbicides, and fungicides on the environment cannot and should not be disregarded due to their high toxicity to both target and non-target organisms. In fact, one of the primary causes of the population fall in some animal species, especially raptors (birds of prey), is pesticides. Thus, it is important to properly and scientifically assess the risk that pesticides and other agrochemicals pose to species and ecosystems (Tennekes, 2015). Insects, rodents, weaver birds, fungus, and nematodes are among the pests that pesticides are used to manage in agriculture. They are also employed in public health to control hazardous organisms and vectors. Since farming occupies almost half of the Hadejia-Nguru wetland area, agricultural lands are essential to biodiversity conservation. Crop productivity is said to be increased by agricultural chemicals. However, environmental pollution, biodiversity, and human and animal health are all adversely impacted by pesticides (Moshi, Didas J, 2015). A solid scientific grasp of the issues must underpin the management of wildlife as pests. Farmers, crop scientists, and ornithologists must pay attention to the survival of birds in rural regions in ord er to coordinate efforts toward Integrated Pest Managem ent (Adekola, 2019).One of the biggest obstacles to wildlif e conservation has been identified as the expansion of th e human population and increased human activity. This is mostly because there are more human-wildlife interactions, which leads to conflicts because of competition for natural resources. Quelea birds are among the many species that are considered problem animals due to their confrontations with humans, includin g agricultural destruction, livestock depredation, and hum an attacks (Flora, 2014). Compared to mammalian and reptilian predators, avian predators appear to be more resilient to extinction and are able to react faster to changes in prey populations, which reduces human-wildlife conflict (Labuschagne, 2016). A major factor in the loss of biodiversity worldwide is agriculture, which results in previously unheard-of drops in species diversity, which in turn lowers ecological services and human well-being. The resilience and ecological integrity of food production systems are particularly threatened by the loss of biodiversity in agricultural landscapes. In order to ensure future food security, it is crucial to address climate adaptation and improve food production given the anticipated rise in human populations and climatic hazards. While simultaneously preserving biodiversity. Increasing food production through modern agriculture's growth and intensification could make biodiversity losses worse. However, efforts to protect biodiversity may result in lower yields or higher macroeconomic costs associated with food production. This increases the trade-offs between biodiversity and food production. Finding opportunities that maximize synergies between food production methods, biodiversity conservation, and ecosystem service supply across agricultural landscapes and food production models is therefore crucial (Tripathi, 2024). In many ecosystems, birds have significant functional responsibilities. The survival of seeds can be reduced by granivorous birds whereas the number of herbivorous arthropods might be decreased by insectivores. Other avian and mammalian predators also use birds as important prey (Keesing, Gadd, Ostfeld, and F.,2008).Birds are pests and scavengers, seed predators and dispersers, pollinators, and ecosystem eng ineers, among many other significant ecological roles the y play in various environments.The third most common s pecies was the redbilled Quelea (*Quelea quelea*), a wand ering pest of cereal crops that feeds in large groups.Its ab undance may be explained by the availability of enough g rains in the area, which may have been augmented by gr ains from other communities' farms (Mgelwa, A S, 2023).

Chemical control of quelea birds

With a population that is constantly growing-roughly seven times larger in 2021 than it was in 1960 (World Bank Group, 2023a)-Kenya is dealing with issues comparable to those in other regions of the world, and boosting food production is consequently necessary. After maize and wheat, rice is the third most important cereal in the nation. However, according to Oerke (2006), animal pests cause 15% of the world's rice crop to be destroyed. Grain-eating birds, including Village Weaver (*Ploceus cucullatus*) and Red-billed Quelea (*Quelea quelea*), are among the major pests in Kenya that significantly reduce rice output. Additionally, the toxicity of rodenticides to secondary consumers varies, and field conditions can mediate scavenger exposure (Keith, James O., 2024). For both migratory and endemic permanent raptors, Africa is one of the most significant continents. In addition to supporting breeding populations for more than 20% of all raptor species worldwide, Sub-Saharan Africa is home to more than 20 regular Palearctic migratory raptors. The remnants of explosives and avicidal sprays used to manage red-billed quelea (*Quelea quelea*) populations in Africa remain in the environment for approximately six and twenty-one months, respectively, as this topic highlights. Optimized spray management, however, can reduce soil contamination and the ensuing harm to environmental health. In Europe, a significant vertebrate pest is the common vole. Additionally, they are a significant source of food for birds that hunt. Barn owls (Tyto alba) and

kestrels (*Falco tinnunculus*), which frequently feed on common voles during the rise phase of an epidemic, are drawn to artificial nest boxes and high common vole abundance. The same issue exists in the northern Nigerian Hadejia-Nguru marshes. The Kenyan Ministry of Agriculture uses night roost sprays of fenthion, a nerve toxin that is toxic not only to birds but also to humans and other non-target animals, to eradicate rice on a wide scale in order to prevent damage. In addition to being detrimental locally, roost spray has the potential to move into waterbodies and destroy aquatic species (Mohammed, 2025). Additionally, it affects animals that consume the afflicted birds as well as insects that are exposed to the sprays. Therefore, using fenthion as a pesticide may have detrimental effects on both human health and biodiversity. Therefore, the goal should be to minimize the usage of roost sprays (Hollsten, 2023).

Biological control of Red billed quelea or use of natural enemies

Figure 1 A and B: Biological control of granivorous birds using Hawks, Falcons and goshawks.

Although it is expensive and resource-intensive, a biological control strategy may be used. The approach entails introducing and enhancing the target bird species' natural predators. (Figure 1 A and B) Herons, storks, falcons, goshawks, owls, hornbills, rollers, kingfishers, crows, and Marabou are among the natural predators. Since this approach has no detrimental effects on the ecology, it might be thought of as the greatest way to manage these bird pests. However, a favorable ecosystem is required to support the introduced natural predators, and its applicability needs to be tested. Another efficient and less expensive strategy than increasing the number of predators is to frighten the birds away by using trained falcons, eagles, and hawks. This is said to be the most effective way to reduce HBC (Human Bird Conflict) because it has no detrimental effects on the ecology. Barn Owls (*Tyto Alba*) are found all over the world and primarily consume rodents, although they also eat insects, birds, reptiles, amphibians, and other small animals. Weavers make up a significant portion of avian prey (Dávid, 2017), and birds play a significant role in the diet of barn owls in Africa, particularly in urban environments. The barn-owl is a significant predator of birds and other non-mammalian vertebrates as reported by (Johnston, 2024). Many weaver species are susceptible to predation by these owls because they breed in colonies and roost in large numbers in trees or reeds. The Red-billed Quelea was the most frequently reported of the eleven-weaver species that the Barn Owl was known to feed on. It may seem odd that weavers, who are diurnal, make up a significant portion of the bird prey that the nocturnal Barn Owl hunts. Nonetheless, Red-billed Quelea breeding colonies draw a wide range of predators, particularly birds of prey like Barn Owls (Oschadleus, 2018). Weavers are abundant, widespread, and frequently found in huge numbers in Africa and the Indian Ocean islands.

Many predators and scavengers, including herons, storks, falcons, goshawks, owls, hornbills, rollers, kingfishers, crows, marabou, shrikes, snakes, lizards, and small mammals, are drawn to the enormous roosts and breeding colonies of queleas. Most steal dead birds or takes nestlings. 50% of children may die (Mathew, 2025). Predators find it challenging to attack a colony when it is in motion because it forms a dense mass. As a high-quality source of protein, people occasionally gather and consume nestlings (Markula, 2016). Over time, trained natural predators of birds, such as dogs and hawks, have been utilized to scare birds. These animals are real threats that drive since falcons are many birds' natural predators, their presence is particularly beneficial in this regard. According to (Cheney, 2020), a dog and its handler can successfully protect crops on a 50-by-50-kilometer plot of land. The dread will be validated by these predators' occasional kills, which could lead to long-term migration from such protected areas. Time, money, and weather restrictions are the drawbacks of this approach. Some persistent pests return to do harm whenever the weather prevents scouting (Suleiman, 2020) birds away from farms.

METHODOLOGY

Systematic literature review was adopted for this paper.

Literature were searched using google search engine such as google scholar, PubMed, ScienceDirect, Taylor and Francis journals and other relevant materials such as text books, chapters and pamphlets. Using the keywords Conservation, Control, Raptors, *Quelea quelea*, and wetlands, Materials were searched on from 2015 to 2026. Materials searched are those that covers Red-billed quelea management using chemical and its limitation, natural enemies of quelea and possible applying natural enemies in controlling quelea. Suggestions on how to improve the population of natural enemies in the study area (Hadejia-Nguru wetlands). Results obtained indicate that numerous studies were conducted detailing the use of chemicals in controlling quelea and outlining its limitations. The Possible application of natural enemies in controlling quelea and ways of conserving the natural enemies. The literature search is limited to use of natural enemies in controlling quelea birds only and suggest some possible means of conserving the natural enemies.

The main issues identified by the study includes sluggish reproduction of the raptors, anthropogenic activities including hunting, habitat loss, electrocution, and secondary poisoning, which are causing the population of birds of prey to severely decline. This review proposes the use of conservation of the raptors as a strategy. This implies that it is possible to reintroduce the Queleas natural enemies, which are birds of prey. This can be accomplished by providing nesting boxes, avoiding the use of chemicals, controlling trade-offs like the use of certain birds and their parts for medicine and rituals, implementing agroforestry, massive afforestation, regulating hunting, and using wetland resources unsustainably. (Suleiman, 2020).

Natural enemies of Red billed quelea

Red-billed queleas are the most significant avian pest in Africa, causing damages of about USD 8.6 million annually (FAO, 2024). They can seriously harm crops of wheat, sorghum, millet, Oats, buckwheat, and rice. They eat insects such as beetles, caterpillars, grasshoppers, crickets, bugs, ants, termite alates, and spiders. At the nest, males perform a visual show by raising and fluttering their wings in addition to singing. The breeding colony's constant clamor of noise makes the visual display crucial. Nestlings have a high mortality rate because many of them fall from their nests or are eaten by predators. A wide variety of predators eagerly consume red-billed queleas and their nestlings because they are an essential part of the food chain. Predation can have a significant effect on breeding colonies, and some may be totally killed by ravenous predators. However, rapid, synchronized breeding can occasionally be successful in overpowering predators. Egrets, herons, hornbills, owls, kites, vultures, eagles, hawks, falcons, shrikes, and storks are among the animals that steal nestlings and fledglings. A wide variety of non-avian predators have been observed at colonies, including rodents, genets, monkeys, baboons, lions (*Panthera leo*), leopards *(P. pardus),* different snakes, and monitor lizards (*Varanus spp*.). Additionally, predatory insects like Armoured Ground Crickets (*Acanthoplus spp.)* may attack colonies. In several African nations, humans also attack breeding colonies and gather a lot of chicks, but this has little to no effect on total populations (Tippett, 2025). To appreciate how animals, carry out their everyday chores, such as locating food, evading predators, attracting mates, and navigating their surroundings, one must comprehend how they gather information from their surroundings. The eyes are the only sensory organs in the animal kingdom that can instantly relay information about their surroundings. Although birds employ a variety of cues, such as the Earth's magnetic field, sounds, smells, visual cues, and more, vision seems to be a crucial sensory modality in these creatures, particularly when foraging. Specifically, birds of prey, sometimes known as "raptors" (as defined below), are thought to primarily use their sense of sight when foraging. In fact, many raptor species detect their prey and food at quite high altitudes where auditory and olfactory cues should be invisible. In the absence of visual obstacles, eyesight may be the sole accessible cue available for prey/food detection. The fact that certain raptor species have the highest visual acuity (also known as spatial resolution) discovered too far for both achromatic, reviewed in, and chromatic patterns highlights their apparent reliance on vision. Determining which species are "raptors" (or birds of prey) has been a contentious issue for decades, despite the fact that exact terminology is crucial in research. "Raptor," which implies plunderer or ravisher, is derived from the Latin word "rapere"(Potier, 2020). The NCA was granted special legislative protection primarily because of raptors, or birds of prey. The ecosystem where breeding birds of prey are found in remarkably large numbers is the result of a special combination of soil, climate, geology, and vegetation. But why are raptors so unique? The Latin word rapere, which means to take or plunder, is where the term "raptor" originates. This is a fitting description of birds that swoop down on their prey. Every raptor has a carnivorous diet, powerful feet with sharp talons, sharp eyesight, and a hooked beak. Feathers, wings, the ability to lay eggs, and warm blood are characteristics shared by all birds, even those as dissimilar as hummingbirds and golden eagles. But certain characteristics set the group of birds called raptors apart from other birds.

Raptor Groups

Like all birds, birds of prey can be categorized into comparable bird groups. The general traits that set falcons apart from hawks, eagles, and vultures are listed below. You can recognize a specific raptor you might see nearby by being aware of these fundamental groupings. You can use the list to navigate to a particular group or browse all of them. Vultures, Owls, Hawks, Eagles,

Figure 2: An American kestrel (*Falcon sparverius*), which deter pest birds in a sweet cherry (*Prunus avium*) Orchard in Michigan USA. Source: (Lindell, 2020)

Buteos, Accipiter's, Harriers, Osprey, Falcons, and Kites. Since the beginning of animal farming, large raptors have likely been considered an annoyance. Given that the majority of large raptors are opportunistic scavengers, accusations are occasionally unfounded. For instance, numerous thorough analyses have revealed that nearly all of the lambs at eagle (*Aquila*) nests were scavenged. However, other research has shown that hawks (*Accipiter*) prey on poultry, eagles (*Haliaeetus*) or ospreys (*Pandion haliaetus*) at fish farms, and Peregrine Falcons (*Falco peregrinus*) prey on trained pigeons near lofts and during races (Tre-leaven 1977). Raptors have long been viewed by game preservationists as rivals for a resource that can be harvested or even as a danger to the survival of game stock. Early field research, however, either revealed that raptors were consuming a little amount of game (Mohammed B. B., 2022) or that raptors and other predators were mostly consuming sick or socially dislocated people. Bird deterrence from crops and airfields has advanced significantly (Newton, 2016). Distress sounds, moving figures that mimic people with guns, and even kites that mimic raptors are examples of frightening tactics. Raptors have been targeted using mirrors and shell crackers, although there is no conclusive proof of their effectiveness. Similar to this, territoriality did not stop goshawks from building up in areas where numerous pheasants were released, despite the theory that it might lessen predation pressure by discouraging con-specifics. By the same token, those with problems should remember that raptor predation can be beneficial too, as when nest boxes are used to in-crease the local density of Barn Owls (Tyto alba) thereby reducing damage by rats in Malaysian oil palm plantations (Kenward, 2024). Bird management presents numerous difficulties and is expensive for farmers and local businesses (Gordon, 2016). First, once they find a food supply, birds are very mobile and persistent, making pest bird management challenging. Second, management plans need to be in line with preserving the biodiversity, soil, water, and air quality that are essential to crop productivity (Millennium Ecosystem Assessment 2005). Third, certain bird species consume and discourage pest birds, while many bird species eat crops (Gordon, 2016) and may provide food safety risks (Smith et al.2020). Increasing "functional biodiversity," which can be helpful in regulating pests through natural predators, is one of the agricultural conservation strategies. According to a survey of European apple (*Malus spp.)* growers (Shaw, 2024), they used a variety of strategies to promote functional biodiversity, such as keeping hedgerows and installing bird nest boxes. Fruit growers are therefore somewhat aware of the possible financial advantages of managing bird damage with natural predators. Crop-damaging birds may be discouraged by birds that prey on or are hostile to crop-eating birds. Bird damage was decreased in a New Zealand wine grape-growing area by reintroducing a native raptor that hunted birds (Lindell, 2020). Small falcons and American kestrels (*Falco sparverius*; Figure 2) decreased the number of fruit-eating birds in sweet cherry orchards, perhaps leading to significant economic benefits for the area. Perches and nest boxes are techniques that can be used to draw aggressive and predatory birds to certain areas of the landscape. Studies to determine the chance of predatory birds using boxes and perches are crucial because the likelihood changes depending on the location. Natural predator species with diminishing populations may benefit from the addition of resources like nest boxes and perches, which could have positive environmental effects (Lindell, 2020). Due to habitat degradation, greater use of poisons, and agricultural intensification brought on by the growing human population, the number of raptors in Africa has drastically decreased in recent decades at a rate of between 70% and 97% (Eunice Kamau, 2022). However, it is challenging to assess the potential for bio-control for vole

Table 1: Important avian predators of major agricultural pest species in Sub Saharan Africa Amar, Arjun, 2018.

Raptor species	Pest (crop)
Black kite (PAM), Shikra, tawny eagle ,steppe eagle (PM), Warlberg's eagle , African harrier hawk, lamner falcon, peregrine falcon, gabar goshawk, Steppe buzzard (PM), augur buzzard, dark chanting goshawk, red-necked falcon	Red-billed quelea (Sorghum, Millet, rice wheat)
Eurasian marsh harrier (PM), Pallid harrier (PM), booted eagle (PM), Steppe eagle (PM), tawny eagle, black -winged kite, long- crested eagle, augur buzzard, Steppe buzzard (PM), Jackal buzzard, Common kestrel (PAM)	Rodents (Rice, Sorghum, Maize Sugar cane
Lesser Kestrel (PM), Common Kestrel, (PM), lamner falcon, African Swallow tailed kite, Steppe eagle (PM), Montagu's harrier(PM), Pallid harrier(PM),black kite (PAM), Amur falcon(PM), red-footed falcon(PM), African cuckoo-hawk, grasshopper buzzard	Locusts(including desert locusts) and grasshoppers(Sorghum, Millet)

Source: The crops in which the raptors were seen foraging on the pest species are indicated in parentheses PM palearctic migrants PAM Palearctic and African Migrant. Adapted from (Amar, Arjun, 2018).

population management because no clear effects of predatory birds on common voles could be found (Jacob, 2013). The natural equilibrium between insect pests and their natural foes can be readily upset by the careless application of insecticides. In order to preserve the populations of natural parasites and predators, it is recommended that spraying insect pests should be avoided. Red-billed quelea (*Quelea quelea*) and other species in Asian rice ecosystems are recognized as persistent issues in sub-Saharan Africa. The majority of Asian nations utilize netting for rice and other crops in order to capture large numbers of birds for food. However, it is also possible for some species to destroy a significant number of nests. Rat populations in rice and plantation crops have decreased in Malaysia as a result of an inventive owl habitat initiative that has successfully increased the number of owls. A plastic trap-and-barrier device has also produced great results in rice fields. The interaction of organisms with the target pests and the environment is the basis for biological management. As a result, it is more complicated than certain conventional methods of controlling pests, such using chemical pesticides. The argument that insecticide use, particularly early in the crop season, disrupts natural enemies is supported by the fact that some insecticides destroy natural enemies (Fahad, Shah, 2015). Because the birds will only breed when there is enough precipitation to create the insects and grass seeds they require to rear young, red-billed queleas (Quelea quelea) likewise rise with the rains. When large numbers of these animals destroy cultivated crops and cattle feed, they can all become major pests. A significant portion of the diet of about 21 raptor species in the Sahel comes from rodents (Table 1). Eight of those species—the Augur Buzzard, Common Buzzard (*Buteo buteo*), Black-shouldered Kite, Montagu's Harrier, Pallid Harrier (*Circus macrourus*), Barn Owl (*Tyto alba*), African Grass Owl (*Tyto capensis*), and White-faced Scops Owl (*Otus leucotis*)—specialize in rodent prey (Moysi, 2018). During disruptions, raptors gather in regions with a high rodent population, and they easily consume animals that have been poisoned during control programs. The afflicted rodents could be dangerous to raptors and other predators, just like dead and moribund locusts and quelea. Predators' vulnerability and their exposure to toxins used to eradicate pests are crucial variables. In Africa, raptors offer essential ecosystem services. For instance, the environmental services that vultures offer fit into three of the four categories recommended by the Millennium environmental Assessment; their characteristic circling indicates where the cadaver is. Vultures also prevent the spread of contagious diseases by clearing carcasses from the environment. Without vultures, carcasses can take up to three times longer to decay, which creates a center for infections that would usually be quickly eliminated, according to research conducted in Africa. Lastly, vultures are a significant cultural treasure in Africa, and more lately, they have become a popular subject for photographs at vulture restaurants. Additionally, there is evidence from West Africa that raptors, like other acridivorous birds, can lower the quantity of locusts or grasshoppers, potentially reducing agricultural impacts. Similar to this, a variety of sedentary and migratory raptors frequently hunt on red-billed queleas (*Quelea quelea*) in grain-producing parts of Africa. These raptors frequently congregate in great numbers in quelea breeding colonies when the nestlings fledge (Amar, Arjun, 2018). A group of several hundred raptors may eat up to 10,000 queleas at a single breeding colony or up to 25% of their young because raptors, like the martial eagle (Figure 3) depending on their size, can eat four to twenty fledgling queleas every day. It's unclear, though, if this kind of predation can affect the size of the population as a whole and the degree of harm they inflict. However, raptors like the Hooded vultures (figure 4) may be more susceptible to pesticide exposure and subsequent poisoning because to their attraction to concentrations of agricultural pest species, particularly avicides and rodenticides (Amar, Arjun, 2018).

Natural Predators

Using predators to drive birds away is another more

Figure 3: Adult martial eagle with prey. The species has declined in many countries, both inside and outside of protected areas. Source: (Amar, Arjun, 2018).

Figure 4: Hooded vultures help to clean up carcasses from the environment and therefore the spread of pathogens. Source: (Amar, Arjun, 2018).

sustainable solution being investigated in Botswana. FAO Southern Africa started a $300,000 project between 2019 and 2021 with the goal of investigating the use of falcons to frighten quelea off crops in Zimbabwe, Zambia, and Mozambique. Falcons might be trained to drive away quelea birds, as proved by a similar two-year effort in Botswana. However, because falcons operate on a local scale, they might not be a suitable replacement for large-scale techniques like spraying. The COVID-19 outbreak in Zimbabwe caused disruptions to the falcon program. Teaching rural farmers how to handle and care for birds presented additional difficulties (Ntuli, 2022). Raptors and corvids typically have sluggish rates of reproduction and are k-selected species (Sabo, 2022). Golden eagles, for instance, usually do not start fledgling every year (Katzner et al. 2020a, b). Numerous raptor species have declined as a result of this poor reproductive rate, reproducing until they are at least five years old, with breeding couples producing an average of less than one with prey or habitat specialization. Following the post-fledging reliance period, or when the young leave their parental region, is the most critical time for avian predator survival (Bashir Babura Sabo, 2021). This period usually has the highest death rate, which is frequently caused by malnutrition or predators (McNew, 2023). The main sources of food are rodents and orthopterans, however when these preys are in short supply, granivorous birds may provide as a substitute (R. B UIJ, 2015). Seed-eating birds were found to be most prevalent in Chad inside the Sudano-Sahel, although their numbers have drastically decreased in West Africa (Zwarts et al. 2018, 2023c, 2023d). For instance, during the 1960s and

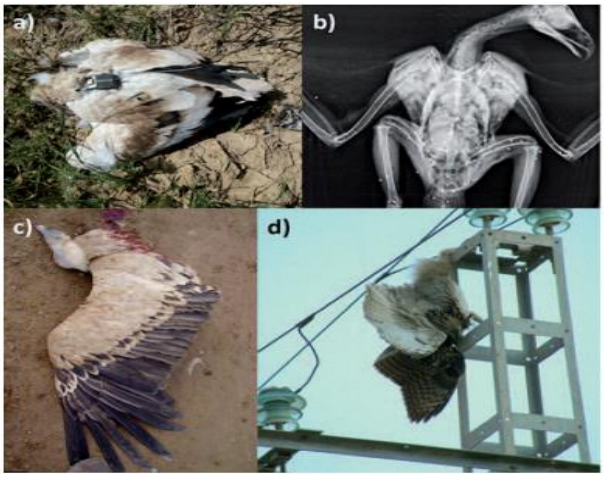

Figure 5: Mortality in birds caused by non-natural factors e.g. killing, poisoning through pesticide application and electrocution .Sources: (Donázar José, 2016)

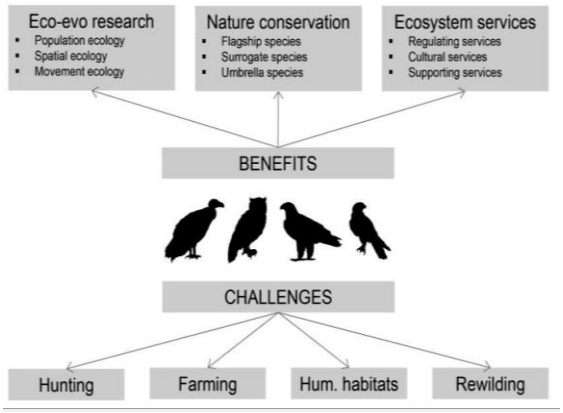

Figure 6: Benefits and challenges of conservation of raptors. Source: (Olubodun, 2025).

2010s, the number of Red-billed Quelea (Quelea quelea), a significant prey of Pallid Harriers in northern Cameroon (Buij 2013), fell by 47–85%, whereas the number of other granivorous birds (at least in NW Senegal) fell by 39–97% (Muhammad, 2022). Except in areas close to wetlands, such as Waza Logone in the Lake Chad Basin, which attracts Palearctic raptors, West Africa has little to offer Pallid Harriers in the form of large flocks of granivorous birds when orthopterans and rodents are scarce. Much less is known about African raptors, aside from vultures and some eagles, regarding trends, migratory shifts, or shifting breeding and wintering ranges. According to, the overall fall in seed-eating passerines in savannah-like environments has led to a significant reduction in the food supply of bird-eating raptors (Bijlsma, Authors, 2023). Because of the constraints imposed by their conservative life strategy (low population density and turnover), birds of prey have been an uncommon study paradigm compared to other avian taxa. However, because many populations have been on the verge of extinction and because they are recognized as flagship species, top predators, and scavengers in ecosystems, they have drawn a lot of attention from the perspective of conservation biology. With the exception of a few vultures that are still severely impacted by illicit poisoning, many populations of birds of prey have seen significant declines after more than a century of persecution (figure 5). The primary factor limiting bird of prey populations in Europe is non-natural mortality brought on by human activity (Donázar José, 2016). In addition to influencing the behavior and demographics of their prey, predators spatially shape communities. Lethal predation is one of the direct effects of predators, while indirect effects increase the danger of predation in prey species. Risk-induced prey characteristics may be driven by these factors numerical reactions in the population of prey. Raptors are frequently the top predators in birds. Thus, understanding their life history characteristics, such as the timing of breeding, breeding densities, clutch and brood size, the size and sex ratio of offspring, and reproductive age, are important indicators of raptor population growth and dynamics that

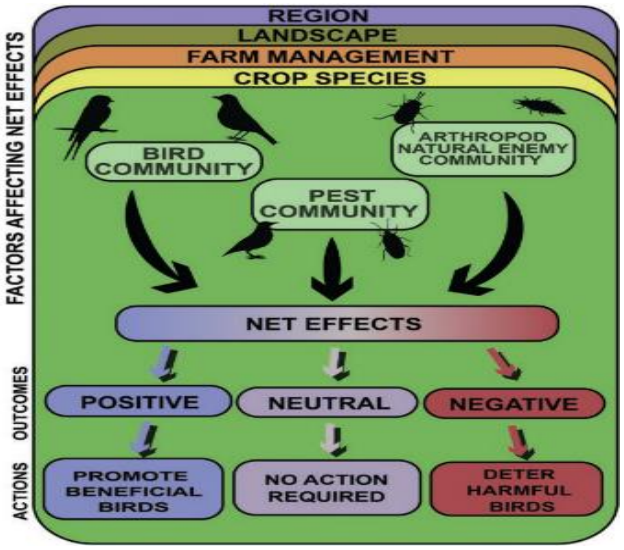

Figure 7: Interactions between bird communities, arthropod natural enemies. Source: (Garcia, 2020)

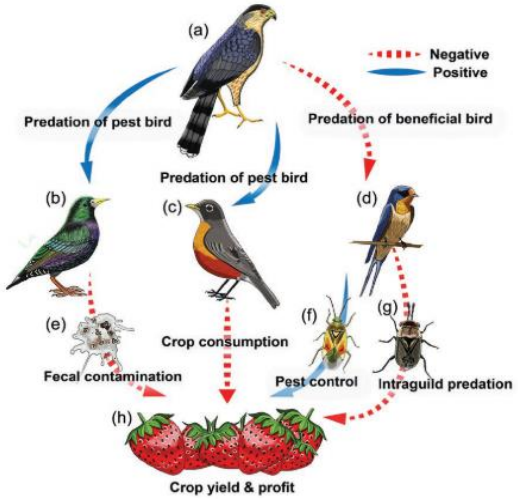

Figure 8: Potential services and disservices that birds may deliver to agroecosystems. Sources (Garcia, 2020)

can offer helpful insight into their effects more generally (figure 6) (Olubodun, 2025). The widespread bird killing that was taking place at the time led to the development of the field of economic ornithology (Abadi, 2024). Birds were being murdered for a number of reasons, such as: 1) valuable collection purposes that indicated socioeconomic level; 2) hat-making and other fashion endeavors; 3) food and sport; and 4) because they were frequently perceived as a threat to agricultural production. Economic ornithology proponents said that it was economically foolish to kill birds carelessly because they offered farmers vital services, such as eating insect pests (Figure 7). Studies on birds in agriculture changed from examining birds as biological agents to examining birds as pests when the area of economic ornithology declined (Garcia, 2020). Nearly 75% of bird species occasionally eat invertebrates, and over 50% of bird species are primarily insectivorous. For instance, compared to control plots without bluebird nest boxes, California vineyards with nest boxes for insectivorous Western Bluebirds (*Sialia mexicana* (Swainson, 1832) [Passeriformes: Turdidae]) provided noticeably more insect pest foraging services (Mostafa, 2012). Furthermore, in Michigan sweet cherry orchards, building nest boxes for the predatory American kestrel (*Falco sparverius* (Linnaeus, 1758) [Falconiformes: Falconidae]) led to a substantial decrease in the number of fruit-eating birds (Figure 8). Deploying nest boxes was therefore a useful, real, and affordable method of improving pest suppression. Likewise, Garcia (2020).

Other natural enemies

The capture of wild birds and their eggs by human beings as sources of food and economic activity has been practiced over the decades. Mass capture, sale, and utilization of birds can compensate for the losses that result from the destruction of crops. The quelea birds can also be mixed with other food stuff like rice, potatoes and banana to form the infants' food supplement (Mmbaga, 2025). Similar to queleas, armoured bush crickets are pests of millet and sorghum in various regions of southern Africa. They also occasionally attack other crops*. A. discoidalis* can be seen in close quarters. They appear to be omnivorous and scavenge opportunistically on everything that is available, such as dead and injured members of their own species or road-killed animals and birds (Emmanuel H., 2022). Because *A. discoidalis's* mandibles are strong and sharp enough to extract human blood, quelea chicks inside a nest are vulnerable to severe harm or even death from cricket assaults. Because *A. discoidalis* may orient itself toward volatile substances and acoustic/vibrational signals. The upper mandibles of the two that were photographed were reduced to stumps with black scar tissue covering their ends, but their bottom mandibles were entire or almost complete. Since we have never seen such abnormalities before, we hypothesize that Armoured Bush Crickets may have caused them by nibbling at nestlings' bills when their mandibles were still soft (Cheke, 2003). The overall prevalence of the gastrointestinal parasite of the infected Red-billed quelea (*Q. quelea*) in the Gyawana ecosystem was 41 (68.33%), according to the results of the intestinal parasite prevalence study. In *Q. quelea*, the prevalence of gastrointestinal parasites is 20 (66.67%) in males and 21 (70.00%) in females. Nevertheless, gender did not significantly differ from gastrointestinal infection ($P > 0.05$) (Emmanuel H., 2022). One of the biggest obstacles to wildlife conservation has been identified as the expansion of the human population and increased human activity. This is mostly because there are more human-wildlife interactions, which lead to conflicts because of competing for natural resources. Quelea birds are among the many species that are considered problem animals due to their conflicts with humans, including agricultural destruction, livestock depredation, and human attacks (Emmanuel H., 2022).

Conclusion

Red billed quelea is a granivorous African pest bird causing damage amounting to over 80 USD to rice farmers. Many techniques including cultural such as scaring birds and use of chemicals are adopted in controlling the pest bird. Using the chemicals affects non-target populations and other environmental damages. This paper highlighted the use of natural enemies of the birds particularly the birds of prey (Raptors). The major challenges are while the population of quelea is increasing exponentially following grain farming expansion, high fecundity and good favourable climate for reproduction. The population of raptors, which are birds of prey, is decreasing due to secondary poisoning brought on by the use of chemicals to control pests. They also have a slow rate of reproduction and are exposed to numerous environmental hazard, including electrocution, habitat destruction, and anthropogenic uses like rituals and trade-offs for financial gain. In order to improve raptor reproduction, this research recommends reintroducing the bird of prey species, altering the Agric-Ecology (agro ecosystem), implementing agro-forestry, providing raptors with nesting boxes, training some species of falcons how deter the pest birds (falconing). Falcons will be trained alongside other species of raptor such as hawks, eagles, etc.

REFERENCES

Abadi, A. (2024). Occasional Occurrences and Distributions of Red Billed Quelea (Quelea quelea) Birds on Cultivating Crops during the Belg Season at Raya Azebo District of Tigray, Ethiopia. *Asian Journal of Research in Crop Science*, 7-16.

Adekola, O. E. (2019). Avian Pests of Cereal Crops in Rainforest and Savanna Agro-Ecological Zones, Ondo State, Nigeria. *Journal of Research in Forestry, Wildlife & Environment*, 11-23.

Amar, Arjun. (2018). Conservation and Ecology of African Raptors. In J. H. al., *Birds of Prey* (pp. 419-455). Cape town: Springer International Publishing AG,. 10.1007/978-3-319-73745-4_18

Amodu, U. U. (2023). Mapping the Distribution and Pestiferous Activities of Quelea Birds in Bayelsa State, Nigeria, Using GPS and GIS. *Journal of Agriculture and Food Environment*, 21-27. DOI:10.17700/jai.2019.1.1.497

Bashir Babura Sabo, S. M. (2021). A Comparative Study of Raptors Species Diversity between Protected and Unprotected Areas of Hadejia Nguru Wetlands, Nigeria. *Confluence Journal of Environmental studies*.

Bijlsma, Authors. (2023). Distribution and Relative Density of Raptors in the Sub- Sahara during the Dry Season Distribution and relative density of raptors in the sub-Sahara during the dry season. *BioOne*, 103-117. https://doi.org/10.5253/arde.2023.a6

Cheke, R. A. (2003). Armoured Bush Cricket attacks on nestling Red-billed Quelea (Quelea quelea). *Ostrict Journal of African Ornithology*, 135. DOI:10.2989/00306520309485382

Cheney, J. A. (2020). From wing shape to fluid dynamics in the barn owl (Tyto Alba). *bioRxiv preprint*.

Dávid, S. (2017). The prey composition of the Barn Owl (Tyto alba) with respect to landscape structure of its hunting area (Zala County , Hungary) . *Ornis Hungarica*, 51-64. DOI: 10.1515/orhu-2017-0015

Donázar José, A. a. (2016). Roles of Raptors in a Changing World: From Flagships to Providers of Key Ecosystem Services. *BioOne*, 181-234. https://doi.org/10.13157/arla.63.1.2016.rp8

Emmanuel H., B. Z. (2022). Prevalance of Gastrointestinal Parasites of Red-Billed Quelea (Quelea Quelea) In Gyawana Ecosystem, Adamawa State, Nigeria. *Journal of Health, Metabolism & Nutrition Studies*, 19-28.

Eunice Kamau, T. K. (2022). *Abundance, Diversity, and Threats Facing Conservation of Diurnal Raptors: Accipitriformes and Falconiformes, on Lewa-Borana Landscape and Ngare Ndare Forest, Kenya.*

Fahad, Shah. (2015). Rice Pest Management and Biological Control. In A. G. E. Lichtfouse, *Sustainable Agriculture Reviews* (pp. 85-106). Bern: Springer International Publishing Switzerland.

FAO. (2024). *Emergency Response to the Outbreak of Red Billed (Quelea Quelea) Birds In Tanzania.* Fao.

Flora, M. (2014). Factors affecting attitudes of local people toward the red-billed Quelea (Quelea quelea) in Kondoa District, Tanzania. *International Journal of Biodiversity and Conservation*, 138-147.

https://doi.org/10.5897/IJBC2013.0655
Garcia, K. (2020). The Good, the Bad, and the Risky: Can Birds Be Incorporated as Biological Control Agents into Integrated Pest Management Programs? *Journal of Integrated Pest Management*, 1-11. https://doi.org/10.1093/jipm/pmaa009
Gordon, I. J. (2016). Reducing agricultural loss and food waste: how will nature fare? *Animal conservation*, 305-308. doi: 10.1111/acv.12290
Hollsten, L. (2023). *Hawk-kite as a scaring method for avian pests in Kenyan rice fields.* Grimsö: Swedish University of Agricultural Sciences Faculty. DOI:10.15421/2018_350
Jacob, J. (2013). Vertebrate pest management: science and application -. *8th European Vertebrate Pest Management Conference special issue. Pest Management Science* (pp. 321-322). Münster,: Institute for Plant Protection in Horticulture and Forests. DOI:10.1002/ps.3496
Johnston, D. W. (2024). Prey Selection of Common Barn-owls on Islands and Mainland Sites. *Journal of Raptor Research,* 3-7. https://digitalcommons.usf.edu/jrr/vol21/iss1/3
Keesing, D. L., Gadd, M. E., Ostfeld, R. S., & F., T. P. (2008). Impacts of large herbivorous mammals on bird diversity and abundance in an African savanna. *Oecologia*, 1-11. doi: 10.1007/s00442-008-0994-1.
Keith, James O. (2024). Review of Hazards to Raptors from Pest Control in Sahelian Africa. *Journal of Raptor Research*, 151-158. https://digitalcommons.usf.edu/jrr/vol32/iss2/12
Kenward, R. E. (2024). Raptor Predation Problems and Solutions. *Journal of Raptor Research,* 1-4.
Labuschagne, L. (2016). Are avian predators effective biological control agents for rodent pest management in agricultural systems? *Biological Control*, 1-45. DOI:10.1002/ps.7421
Lindell, C. A. (2020). Supporting farmer adoption of sustainable bird management strategies. *Human–Wildlife Interactions*, 442-450. https://www.jstor.org/stable/27316222
Markula, A. (2016). *Red-billed quelea Pest animal risk.* Queensland: State of Queensland.
Mathew, E. D. (2025). Impact of Red-Billed Quelea (Quelea Quelea) On the Livelihood of Rice Farmers in Zabarmari Village Of Jere Local Government Area, Borno State. *Journal of Arid Agriculture*, 23-30.
Mcnew, L. B. (2023). Avian Predators in Rangelands. In *Rangeland Wildlife Ecology and Conservation* (pp. 471- 504). Cham: Springer Nature Switzerland AG. DOI:10.1007/978-3-031-34037-6_14
Mey, Y. (2013). Bird Damage to Rice in Africa: Evidence and Control. In M. W. al., *Realizing Africa's Rice Promise* (pp. 240-248). London: CAB International. DOI:10.1079/9781845938123.0241
Mgelwa, A S. (2023). Avifauna Community in a Threatened Conservation Landscape, Western Tanzania: A Baseline. *Tanzania Journal of Forestry and Nature Conservation*, 10-24. https://doi.org/10.4314/tjfnc.v92i1
Mmbaga, N. (2025). Land use changes and the distribution of the red - billed Quelea (Quelea quelea) in Chemba district , Tanzania. *Discover Sustainability*. https://doi.org/10.1007/s43621-025-01177-x
Mohammed, B. B. (2022). Population Distribution of Birds of Prey in Hadejia- Nguru Wetlands Nigeria. *Arid Zone Journal of Basic and Applied Research*, 62-79. doi.org/10.55639/607uoic
Mohammed, I. N. (2025). Impact of Damage on Rice crop by the Red-billed Quelea (Quelea quelea) on the livelihood of Farmers in Hadejia- Nguru wetlands of Northern Nigeria. *Journal of Agricultural & Env. Sci. Research*, 32-48. https://doi.org/10.70382/hujaesr.v10i1.039
Moshi, Didas J. (2015). Health risks of pesticides to non-target species and ecosystem due to control of migrant pests in Tanzania. *Journal of research in environmental science and toxicology*, 20-27.
Mostafa, M. A. (2012). Wild Birds Injurious To Some Field Crops at Ismailia Governorate under Field Conditions. *Journal of plant protection and pathology*, 1067-1077.
Moysi, M. (2018). Spatial and temporal patterns in the diet of barn owl (Tyto Alba) in Cyprus. *Journal of Biological Research-Thessaloniki*, 1-8. https://doi.org/10.1186/s40709-018-0080-8
Muhammad, S. I. (2022). Waterbird Population Estimates in Hadejia-Nguru Wetlands: Analysis of a Waterbird Population Estimates in Hadejia-Nguru Wetlands: Analysis of a Five-Year Monitoring Program. *Wetlands*, 1-10. https://doi.org/10.1007/s13157-022-01532-y
Newton, I. A. (2016). Review article a review of survival estimates for raptors and owls. *IBIS*, 227-248.
Ntuli, G. (2022, November 8). *UNDP Zimbabwe.* Retrieved from The Tomorrow War - Controlling Quelea Swarms and Ultimately Africa's Future | United Nations Development Programme: https://www.undp.org/zimbabwe/blog/tomorrow-war-controlling-quelea-swarms-and-ultimately-africas-future
Olubodun, O. P. (2025). Breeding biology of the African Pygmy Falcon:long - term variation and seasonal decline in breeding performance of an arid zone raptor. *Journal of Ornithology*, 1-17. DOI:10.1007/s10336-023-02065-9
Oschadleus, H. D. (2018). WEAVERS AS PREY OF BARN OWLS. *Biodiversity Observations*, 1-8.
Potier, S. (2020). Visual Adaptations in Predatory and Scavenging Diurnal Raptors. *Diversity*, 1-14. https://doi.org/10.3390/d12100400
Pringle, S. (2022). Increases in subsistence farming due to land reform have negligible impact on bird communities in Zimbabwe. *Ecology and Evolution*, 1-20. DOI:10.1002/ece3.8612
R. B UIJ, G. N. (2015). Trade of threatened vultures and other raptors for fetish and bushmeat in West and Central Africa. *Oryx*. Doi: 10.1017/S0030605315000514
Sabo, B. B. (2022). Assessment of raptor species relative abundance in Hadejia Nguru Wetlands, Nigeria. *Gadau Journal of Pure and Allied Sciences*, 189-199. DOI: https://doi.org/10.54117/gjpas.v1i2.37
Shaw, P. (2024). African savanna raptors show evidence of widespread population collapse and a growing dependence on protected areas. *Nature ecology & evolution*, 45-56. https://doi.org/10.1038/s41559-023-02236-0
Suleiman, I. (2020). A Review of Bird Pest Repellent Systems in Farms. (pp. 1-15). Wukari.
Tennekes, F. S.-B. (2015). Environmental Risk Assessment of Agrochemicals — A Critical Appraisal of Current Approaches. In *Toxicity and Hazard of Agrochemicals* (pp. 1-39). London: Intechopen.
Tippett, R. (2025, March 19). *Red-billed Quelea (Quelea quelea)*. Retrieved from Red-billed Quelea (Quelea quelea) | BDI: https://thebdi.org/2024/06/24/red-billed-quelea-quelea-quelea/
Tripathi, H. G. (2024). Farmers' biodiversity knowledge improves natural enemy conservation in agricultural ecosystems. *Crop Protection*, 1-8.