



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

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Authors' contributions

This work was carried out in collaboration among all authors. All authors read and approved the final manuscript.

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ABSTRACT

The Belg season plays a crucial role in the agricultural calendar of the Raya District, particularly due to the shortage of rainfall during the summer season. This seasonal pattern of rainfall scarcity necessitates the significance of the Belg season for agricultural activities in this region. Aim of the study was to assess the Quelea bird incidence and its association agronomic practice and environmental factors. Field survey was conducted in Raya-azebo district during 2024 Belg season. A total of 49 farmers field were assessed for the incidence and prevalence of the quelea bird. Result indicated that out of the assessed fields, 69.39% was affected by Quelea birds the assessed fields.

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The damage level caused by birds was varied from 0% to 100%. On average, it was determined that approximately 32.37% of the cultivated crops were affected by birds. The mean percentage of crop damage across all kebelles was observed. Ewo had the highest mean damage at 61.45%, followed by Kara-Adishaho at 57.5%. On the other hand, Tsigea experienced a significantly lower damage rate of 1.67% followed by Genete with damage rate of 11%. Independent variables such as crop types, planting time, harvesting time, source of water, and coverage of trees play a significant ($p < 0.05$) role in influencing bird damage in Belg season crops. The lowest bird damage percentage were observed in crops planted in middle March, with 6.19% and late May harvesting, with a rate of 19.38%. Adopting practices such as cultivating crops in clusters and planting crops of similar maturity at the same time can be effective strategies for controlling *Quelea* birds' damage in agricultural settings.

Keywords: Belg season; *Quelea* bird; crop damage; planting and harvesting time.

1. INTRODUCTION

Belg season holds immense importance in the agricultural practices in Ethiopia, primarily due to the shortage of rainfall during the summer season. The commencement of Belg marks a critical period for farmers to cultivate their crops and mitigate the impact of water scarcity on agricultural production in this region. The Belg season, which spans from *January to May*, is a crucial time for crop production in the country. This period is particularly important for the planting and growth of several essential crops, including teff, maize, wheat, barley, and sorghum. These crops significantly contribute to the country's agricultural output and food security [1].

Despite the significance of the Belg season in Ethiopian crop production, there are challenges that farmers face, including climate variability, land degradation, and limited access to inputs and markets, insect pest and birds. Among these, *Quelea quelea* birds are likely to be the ones that cause significant damage to crops for Belg season crop production in the Raya-Azebo district. The most common migratory birds observed in Raya Tigray include Quele, storks, egrets, herons, and wheatears [2].

Among these *Quelea quelea* birds are known for their remarkable migration behavior, particularly during the transition from the dry season to the wet season, primarily due to changes in temperature, food availability, and breeding habits. Raya Tigray, a region in northern Ethiopia, is home to several migratory bird species that visit the area during the Belg season. This migration is triggered by the onset of rain and plays a crucial role in their survival and reproduction. During this time, the landscape is transformed with abundant vegetation growth and increased water

availability. This change in environment attracts various insects, small mammals, and amphibians, providing a rich food source for the migratory birds [3]. It is particularly problematic for farmers in this district during the Belg season. *Quelea quelea* birds are known to feed on grains such as sorghum, teff, wheat and corn, which are common crops during the Belg season. Therefore the current study was conducted to assess the occasional occurrence and distribution of *Quelea quelea* birds in Belg season in farmers' field in Raya-azebo district during 2024 season.

2. MATERIALS AND METHODS

2.1 Description of Study Area

The experiment was conducted in the Belg season (*January to May*) during 2024 under field conditions at Raya-azebo district. The experimental site is located in the south eastern part of Tigray within latitude ($12^{\circ}39'59.99''$ N) and longitude ($39^{\circ}44'59.99''$ E) with an altitude ranging from 930 to 2300 meter above sea level. It is found in the Southern administrative zone of Tigray located 126 km to the south of Mekelle city (Fig. 1). The district covers an area of about 176,210 ha and comprises about 60% of the Raya Valley, which is part of the Ethiopian rift system [4]. The district is characterized by having bimodal type of rainfall pattern with light rains during February to April and heavy rains between July to September. The mean annual rainfall is about 724 mm with mean daily maximum and minimum temperatures of 18.3°C and 13.93°C respectively for the western highlands, and 23.44°C and 19.64°C respectively in the valley. About 90% of the district is described as "midland" and 10% as "lowland".

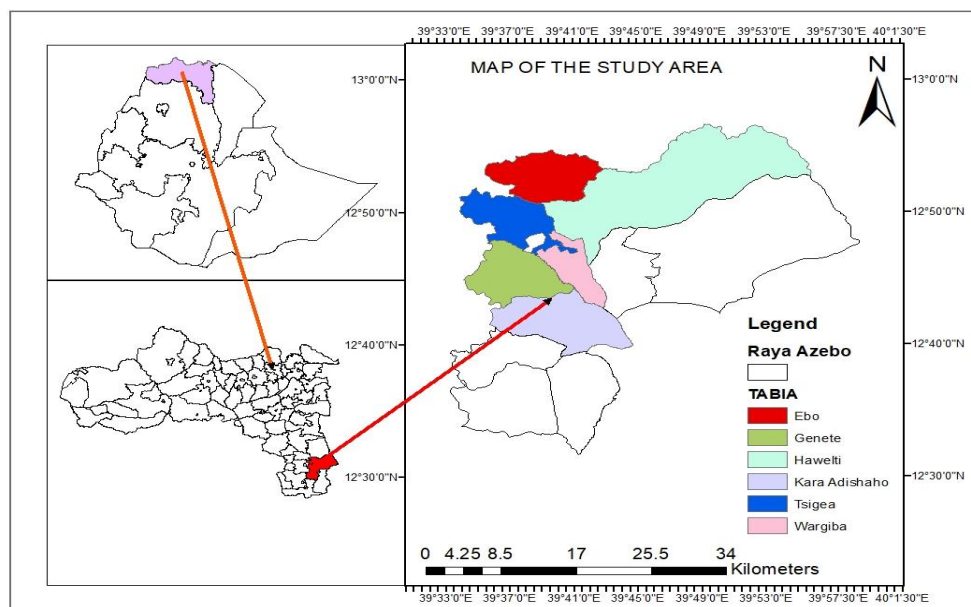


Fig. 1. Maps of Ethiopia, Tigray and Raya-azebo district where the occasional occurrence and distribution of *Quelea quelea* birds' survey study were performed.

2.2 Assessment the Impact of *Quelea quelea* Birds on the Farmers Field

To determine the prevalence and incidence of birds a total of 49 fields were randomly assessed in the Raya-azebo district. A total of six Kebeles (Tabia) (the lowest administrative unit) were assessed: (Ewo, Hawelti, Tsgiea, Genete, Wargiba and Kara-Adshaho). The representative kebeles were selected based on the area coverage under cereal crops production and number of farmers cultivating the crops.

Assessment for bird prevalence and incidence were observed on farmer's field/ farm. Survey was conducted once per growing Belg season (January to May) at maturity stage of the crop. Prevalence in this case reference to the occurrence of *Quelea* birds across the assessed areas (kebeles and farmers' fields). Sampling sites within each Kebele were separated by at least 1 km and at most 5 km apart from each other. Then bird incidence was computed as mean percentage showing typical damage by the birds. According [5] crop damage due to *Quelea* birds was categorized into three levels: minimal (>5%), moderate (>5-50%), and severe (>50%), based on the percentage of damaged crops.

2.3 Agronomic Data

In each surveyed area; additional detailed information such as crop type, planting time,

harvesting time, sources of water and presence of trees (forest) around the farm was collected. Altitude, longitude and latitude of each assessed field were recorded using GPS.

2.4 Data Analysis

The mean *Quelea* birds prevalence and yield losses (damage) in the different Belg season growing Kebeles (Tabia) and farmers' fields were analyzed using the SPSS version 20 (IBM SPSS statistics 20, Armonk, New York) software. ANOVA was performed using the SPSS version 20 to know the interaction effects with in variables (groups).

3. RESULTS AND DISCUSSION

3.1 Occurrence and Distribution *Quelea quelea* (red-billed quelea) Birds

Quelea quelea birds pose a significant challenge during the Belg growing season in the Raya-Azebo district, which are considered potential agricultural regions. *Quelea quelea* birds can cause extensive damage to Belg crops during their growing season (Fig. 3). They feed on the crops, leading to reduced yields and economic losses for farmers in the region. The study conducted in the district aimed to analyze the impact of various independent variables on bird damage, specifically focusing on Belg season cultivated crops. The independent variables

considered in the research were kebelles (administrative units), crop types, planting time, harvesting time, source of water, and coverage of trees (bush). The findings revealed that all these factors exhibited significant variation in their influence on bird damage, ultimately leading to yield losses in the Belg season crops (Table 1). Bird damage in agriculture is a significant issue that poses challenges for growers worldwide. The result is supported by [6] who report birds can cause extensive harm to crops, resulting in economic losses and frustration among farmers. The lack of reliable information on effective control techniques further exacerbates the problem, making it difficult for growers to mitigate bird-related losses efficiently. In addition [7,8] the loss of crop yield due to birds is a significant concern for farmers across the country. Birds such as sparrows, crows, and parrots can cause substantial damage to crops, leading to economic losses for farmers.

According to the surveys' finding, out of the assessed fields, 69.39% was affected Quelea birds. Bird problem was preventing across all survey kebelles. Assessment was conducted at six kebelles on forty nine farmer's field. Bird prevalence varies greatly across the field, in which some of the fields were free of the bird's problem whereas in some other fields 100% of the crops affected by the birds. The damage level caused by birds was varied from 0% to 100%. This means that in some cases, there was no damage at all, while in other instances, the entire crop was affected by bird. On average, it was determined that approximately 32.37% of the cultivated crops were affected by birds. This figure represents the mean percentage of crop damage across all observed kebelles. The mean damage of crops in different locations is presented as percentages. Ewo had the highest mean damage at 61.45%, followed by Kara-Adishaho at 57.5%. On the other hand, Tsigea experienced a significantly lower damage rate of 1.67% followed by Genetie with damage rate of 11% (Table 2). The result is agreed with [9] there are numerous strategies available for controlling *Quelea quelea* birds' populations without relying on pesticides. Each method (cultural control, trapping, explosives, and so on) has its advantages and limitations, and often a combination of approaches yields the best results in protecting crops while promoting ecological balance.

3.2 Effect of Planting and Harvesting Time on Quelea Bird Incidence

3.2.1 Effect of planting time on Quelea bird incidence

In the study conducted, it was found that there was a significant difference in bird damage based on the planting date. The statistical significance was noted at a p-value of less than 0.01, indicating a high level of confidence in the observed difference. This suggests that the timing of planting had a notable impact on the extent of bird damage experienced in the experiment. The highest mean bird damage was observed in crops planted in early January, with a significant percentage of 89.46% being affected by birds. This suggests that crops planted during this period were more susceptible to bird attacks, leading to substantial losses. Following the early January planting date, crops planted in late February experienced a lower but still considerable level of bird damage at 21.67%. While not as severe as the early January planting, this planting date still faced notable challenges from bird predation. In contrast, the lowest bird damage was recorded in crops planted in middle March, with only 6.19% of the plants being affected by birds (Table 3). This indicates that choosing a later planting date, such as middle March, could potentially reduce the risk of bird damage and improve crop yield. The results imply that varying the planting date can influence the vulnerability of crops to bird damage. This finding underscores the importance of considering planting schedules as a potential strategy for managing bird-related agricultural challenges. By adjusting the timing of planting, farmers may be able to mitigate or reduce bird damage to their crops effectively. Planting time is a critical factor that influences bird damage in sunflower crops, as highlighted by [10]. Understanding and addressing factors that contribute to bird damage are essential for effective crop management and protection.

3.2.2 Effect of harvesting time on Quelea bird incidence

The incidence of bird damage on Belg cultivated crops varies significantly depending on the harvesting date. A study found that the timing of harvesting can have a notable impact on the extent of bird damage observed in the crops. The research indicated that the highest mean of bird damage, reaching 80%, was recorded when

crops were harvested in late April. This suggests that birds may be more active or attracted to crops during this period, leading to a higher incidence of damage. Following late April, early May showed a bird damage rate of 37.38%. However, bird damage decreased on middle May compared to early May, with a rate of 27.11%. This suggests that as the harvesting season progresses, there may be fluctuations in bird activity and subsequent crop damage. The lowest bird damage percentage was observed in late May, with a rate of 19.38% (Table 3). This indicates that towards the end of May, there was a notable reduction in bird-related crop damage

compared to earlier harvesting periods. The result is lined with Research by harvesting before the breeding season of *Quelea* birds, utilizing irrigation cultivation methods, and selecting short duration crop varieties are key components of an effective control strategy to mitigate bird-related destruction in agricultural settings. The result is lined with [11] who reported that average yield loss per hectare caused by *Quelea* birds is reported to be over 30%. This substantial reduction in crop productivity can have significant economic consequences for farmers who rely on their harvests for income and food security.



Fig. 2. Incidence and severity of *Quelea quelea* birds on the crop field

Table 1. ANOVA results of kebelles (Tabia), crop types, planting time, and harvesting time, source of water and coverage of tree on bird damage (yield losses)

		Sum of Squares	df	Mean Square	F. value	Sig.
Kebelles	Between Groups	25575.538	5	5115.108	4.77	0.001
	Within Groups	46109.849	43	1072.322		
	Total	71685.388	48			
Crop types	Between Groups	58581.763	2	29290.88	102.825	0.00
	Within Groups	13103.625	46	284.861		
	Total	71685.388	48			
Source of water	Between Groups	39519.074	1	39519.07	57.744	0.00
	Within Groups	32166.314	47	684.39		
	Total	71685.388	48			
Coverage of tree (bush)	Between Groups	34424.71	1	17212.36	21.249	0.00
	Within Groups	37260.678	47	810.015		
	Total	71685.388	48			
Planting time	Between Groups	58675.994	3	19558.67	67.654	0.001
	Within Groups	13009.394	45	289.098		
	Total	71685.388	48			
Harvesting time	Between Groups	14688.971	3	3672.243	2.835	.035
	Within Groups	56996.417	45	1295.373		
	Total	71685.388	48			

Note: Sig: Significant; df: Degree of freedom

Table 2. Occurrence and distribution of Quelea quelea birds in Belg season growing areas of Raya-azebo district

Kebelle (Tabia)	Sample farm				Std. Error	95% confidence interval	
		Maxi	Min	Mean		upper	lower
Awo	11	95	0	61.45	1.26	36.61	82.57
Gentie	5	50	0	11	9.86	0	33.33
Hawelti	9	65	0	14.89	6.91	3.5	36.61
Kara adshu	8	100	0	57.5	15.17	25	87.5
Tsiga	6	5	0	1.67	1.03	0	3.75
Wargba	10	100	0	25.1	12.84	4.82	52.5
Total	49	100	0	32.37	5.53	21.14	42.77

Table 3. Effects of planting and harvesting time on Belg season cultivated crops for Quelea birds

Activities	Sample size	Mean	Std. Error	95% Confidence Interval	
Planting time				upper	lower
Early January	13	89.46	2.96	83.21	95.5
late February	3	21.67	13.8	0	50
Early march	17	15.24	5.83	4.93	28.53
Middle march	16	6.19	2.05	2.34	10.33
Total	49	32.37	5.53	21.14	42.77
Harvesting time					
late april	6	80	12.39	50	100
Early may	8	37.38	15.79	6.5	69.33
Middle may	8	27.11	8.3	5.84	38.33
late may	27	19.38	6.74	14.46	41.24
Total	49	32.37	5.45	22	43.63

3.3 Effect of Crop Type on Quelea Birds' Incidence

Quelea birds are known to cause significant damage to crops, impacting agricultural yields. The incidence levels of damage caused by Quelea birds vary across different crop types. In a study conducted, the following results were obtained regarding the damage levels on specific crops: The highest mean value of damage was recorded on wheat, with a yield loss (sever) of 100%. This indicates that wheat crops experienced the most severe impact from Quelea bird damage, following wheat, sorghum crops were also significantly affected by Quelea birds, with a mean value of yield losses (sever) at 82.88%. Sorghum cultivation suffered substantial damage as well. In contrast to wheat and sorghum, Teff crops showed the lowest mean value of damage at moderate with value 11.75%. Teff was relatively less impacted by Quelea bird damage compared to wheat and sorghum (Table 4). Clustering sowing of teff appears to result in lower damage from quelea birds compared to sorghum and wheat. However, despite this advantage, teff is still considered less preferable than other crops like sorghum and wheat. The result lined with [12,

13, 14, 15] Quelea bird pest described as "similar" is a significant threat to small seeded cereals in Sub-Saharan Africa. This pest is known for its destructive nature, causing substantial damage to crops in the region. Farmers often face challenges in controlling this bird due to its high population and feeding habits that target small seeded cereals.

3.4 Effect of Source of Water and Forest Coverage on Quelea quelea Bird

Birds can cause significant damage to crops, leading to economic losses for farmers. The presence of water and forest coverage in agricultural areas can play a crucial role in influencing the extent of crop damage by birds. The combination of water bodies and forest coverage in close proximity to agricultural areas can create an environment that is highly attractive to birds. Birds may utilize both resources interchangeably, moving between water sources for sustenance and forests for shelter. This dynamic interaction between water and forest coverage can intensify the pressure exerted by birds on nearby crops, leading to more significant levels of damage (Fig. 2).

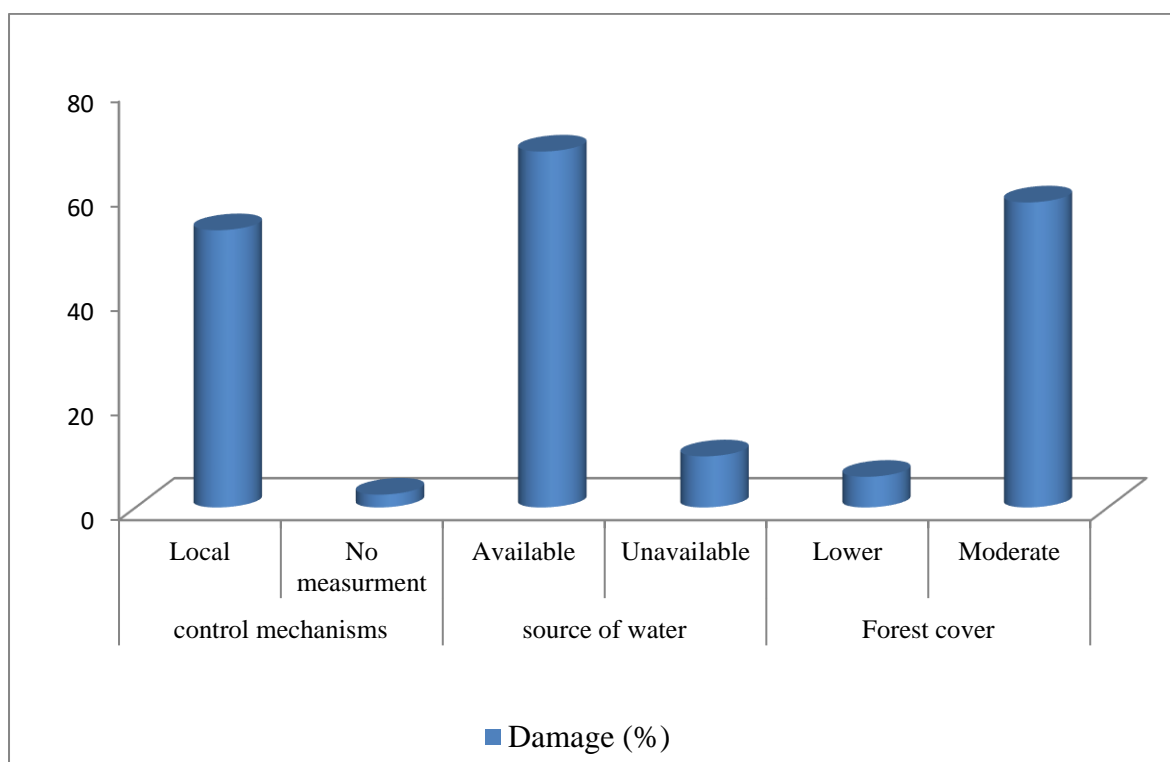


Fig. 3. Effect of water sources and available of trees on occurrence of Quelea bird

Table 4. Effect of crop type on *Quelea quelea* birds incidence

Crop type	Sample farm	Mean	Max	Min	Standard deviation	Crop damage
Sorghum	8	82.88	95	75	6.79	Sever
Wheat	5	100	100	100	00	Sever
Teff	36	11.75	75	0	19.11	Moderate
Total	49	32.37			38.65	



Fig. 4. Farmers covering harvested crops with plastic and nets

3.5 Effects of Covering Harvested Crops with Nets and Plastics from Quelea Birds Damage

Bird protection measures in agriculture are essential to minimize crop damage caused by birds. One common method used by farmers is covering harvested crops with nets and plastic. While this practice can be effective in protecting crops from bird damage, its applicability is limited due to cost constraints. Covering harvested crops with nets and plastic serves as a physical barrier that prevents birds from accessing the crops. Farmers often resort to various methods to protect their crops from bird predation, including covering harvested crops with nets and plastic. While these practices serve the primary purpose of safeguarding the harvest, they also inadvertently provide a protective measure for birds (Fig. 4). This method is particularly effective for smaller areas where the cost of implementation is manageable. By creating a barrier between the birds and the crops, farmers can reduce the risk of bird-related losses.

4. CONCLUSION

Result of the current study indicated that *Quelea quelea* bird is the major challenges and hedge to crops cultivated on Belg season Raya-azebo district on the assessed kebelles. The presence of Quelea bird during the Belg season in Raya-Azebo poses a significant challenge to crop cultivation in the region. Understanding bird behavior and implementing appropriate mitigation strategies are essential for minimizing the negative impact of Quelea birds on agricultural activities. The lowest Quelea bird incidence (damage) was recorded from Teff crop. However, the highest mean yield damage (losses) was recorded from wheat followed by sorghum crop. In addition, lowest yield damage calculated from middle march planting crop. In contrast, highest mean value of bird incidence was observed from early sowing crop types. Beside, farmers planting crops that mature around the same time can reduce the window of vulnerability to quelea bird attacks, as the birds are less likely to focus on a single area when there are multiple fields with ripe crops available. In conclusion, adopting practices such as cultivating crops in clusters and planting crops of similar maturity at the same time can be effective strategies for controlling Quelea bird damage in agricultural settings.

DISCLAIMER (ARTIFICIAL INTELLIGENCE)

Author(s) hereby declare that NO generative AI technologies such as Large Language Models (ChatGPT, COPILOT, etc) and text-to-image generators have been used during writing or editing of this manuscript.

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COMPETING INTERESTS

Authors have declared that no competing interests exist.

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