



ADDIS ABABA UNIVERSITY

COLLEGE OF NATURAL AND COMPUTATIONAL SCIENCES

DEPARTMENT OF ZOOLOGICAL SCIENCES

The Impact of Red Billed Quela (*Quela quela*) on Agricultural Products in Merti woreda, Oromia Region, Ethiopia

By: Mustefa Abadir

A Research Submitted to the Department of Zoological Sciences, Collage of Natural and Computational Science, in Partial Fulfillment of the Requirements for the Degree of Masters in Zoological Science

Advisor:- Dr. Bezawork Afework

August 2025

Addis Ababa, Ethiopia

Approval sheet

Addis Ababa University

College of Natural and computational Sciences

Department of Zoological Sciences

The Impact of Red Billed Quela (*Quela quela*) on Agricultural Products in Merti Woreda, Arsi Zone of Oromia. A Study Title is submitted to the Department of Zoological sciences, Collage of Natural and computational Sciences, Addis Ababa University, in partial fulfillment of the requirement for the degree of Master of Science in Biology.

By: Mustefa Abadir

As member of the examining Board of the final M.Sc.thesis open defense we certify that we have read and evaluated the thesis prepared by Mustefa Abadir Abdulkedir and examined the candidate. We recommended that the thesis would be accepted as fulfilling the requirement for the degree of Master of science in Biology.

1. Advisor

Dr. Bezawork Afework

Signature_____ Date _____

2. Examiner

Dr. Mesele Yihune

Signature_____ Date _____

3. Chair Person

Name _____ Signature _____ Date_____

Acknowledgements

First and for most I want to thanks my Allah! for his protection throughout my life and Next my deepest heartfelt thanks to my Advisor Dr. Bezawork Afework (Ph.D.) for his assistance, genuine professional and technical advice, constructive and valuable suggestions for the completion of this research paper. Secondly a grateful thanks to my wife Hasima Amad Edao as well as my Father and my mother whose words of encouragement and prayer served me as source of strength and inspiration throughout my study.

Thirdly I wish to acknowledge the contribution of Merti district agricultural and rural development office for providing me all the valuable materials and information. I would like to appreciate individuals who have contribution to the completion of this work with special thanks to all members of the sample communities who freely gave of time and information during the individual interview or questionnaire. Finally I thanks all my friends A/selam osman, Sultan sheko, Habib Mohammed and Issa Girsha for their friendly support during this work.

Table of contents

Approval sheet	II
Acknowledgements.....	III
Table of contents.....	IV
List of Tables	VI
List of Figure.....	VII
Abstract	VIII
CHAPTER ONE	1
INTRODUCTION.	1
1.1 Background of the study	1
1.2. Statement of the problem.....	3
1.3 Objectives of the study	4
1.3.1.General objective.....	4
1.3.2. Specific Objectives.....	4
1.4. Research question	4
1.5. Significance of the study	5
CHAPTER TWO	6
REVIEW OF LITRATURE.....	6
2.1 The Red-billed Quela (<i>Quela quela</i>)	6
2.2 Distribution and Habitat of the Red-Billed Quela Birds	7
2.3 Breeding Biology.....	8
2.4. Feeding.....	9
2.5. Roosting.....	9
2.6. Migration	10
2.7. Damage Caused by the Red-Billed Quela Birds	11
2.8.Traditional Approaches for Protecting Cereal Crops from Birds.....	11
2.9. Type and stage of crop damaged	13
CHAPTER THREE	14
MATERIAL AND METHODS	14
3.1 Description of the study area	14
3.2 Data Collection	15

3.2.1. Population, Sample Size and Sampling Technique.....	15
3.2.2 Questionnaire	17
3.3 Data Analysis.....	17
CHAPTER FOUR.....	18
RESULTS	18
4.1.Demographic characteristics.....	18
4.2. Economic Activity	20
4.3. Type of crop cultivated and yield	21
4.4.Reasons of low productivity	22
4.5.Effect of Quela on agricultural productivity cereal crops	23
4.6.Methods of quela control.....	24
CHAPTER FIVE	26
DISCUSSION	26
CHAPTER SIX.....	28
CONCLUSION AND RECOMENDATION.....	28
6.1 Conclusion	28
6.2 Recommendation	29
6. REFERENCES	30
APPENDICES	32

List of Tables

Table 1	Summary of population and sample size in the research area.....	17
Table 2	Demographic characteristics of representative respondents.....	19
Table 3	Economic activity of respondents.....	20
Table 4	Types of crop cultivated and yield.....	21
Table 5	Response of respondents on reasons of low productivity.....	22
Table 6	Effect of red billed quela on the productivity.....	23
Table 7	Methods of quela control.....	25

List of Figure

Figure 1 Red billed quela.....	7
Figure 2 Map of the Study Area.....	15

Acronym

CABI - Center for agriculture and bioscience international

FAO - Food and agriculture organization

GDP - Gross domestic product

ITCZ - International convergence zone

MDG - Millennium development goal

MWAO - Merti woreda agricultural office

Abstract

In Ethiopia crop production is the leading sub-sector of agricultural economy where more than 60% of agricultural GDP originated from crop production. The objective of this research was to assess the impact of Red Billed Quela (Quela quela) on Agricultural Products in Kola Kebele of Merti woreda, Oromia region, Ethiopia. Quantitative research methodology was employed to collect data where structured questioner was used to 100 farmer household respondent selected using simple random sampling techniques. The data was analyzed by tables percentage and frequency. The results showed that quela bird infestation is a major barrier to food security and livelihood sustainability in Merti woreda, and that improved, integrated, and institutionalized control strategies are needed. Mixed farming systems, productivity levels remain moderate, with most farmers harvesting only 11–15 quintals per year, reflecting both the small landholding size and recurrent bird-related losses. Farmers largely depend on traditional control methods such as scaring and with 70% applying all available methods. Institutional and government measures were found to be weak or inconsistent, forcing communities to rely heavily on indigenous knowledge. In addition, limited irrigation infrastructure, poor land accessibility near water sources, and inadequate extension services further constrain productivity improvements. Only 4% of respondents had experience with irrigated sorghum cultivation, and 30% had received guidance from agricultural institutions. Both season of bird outbreak and harvesting time in autumn causes vulnerability and making farmers highly exposed to crop loss. Farmers recommended that strengthening government intervention, facilitating the society at the time of bird migration to prevent the severity of the cereal crops additionally enhance the traditional control methods for best management of the quela birds.

Keywords: *Quela quela*, sorghum, crop loss, traditional pest management, Ethiopia, avian pest

CHAPTER ONE

INTRODUCTION.

1.1 Background of the study

Red-billed queelas are capable of destroying entire crops, over areas up to 1000 hectare. An individual quela consumes an average of 18 grams of grain per day Ibsa Dawid and Feysal Mohammed (2021). It is not unusual for flocks to number into the millions, so a flock of 2 million birds can eat up to 50 tones of grain in a day, or 1500 tones within 30 days, which is worth approximately US\$600,000. In addition to this A range of cereal grains including sorghum, wheat, barley, corn and sunflowers worth an estimate \$429 million per annum (Australian Bureau of Statistics, 2008) could be at serious risk.

The red billed quelea (*Quela quela*) is recognized as one of the most abundant and destructive avian pests affecting cereal crops across Africa, particularly in semi-arid regions. This small finch, measuring about 11 to 13 cm and weighing 15-20 grams, feeds primarily on small grains such as sorghum, millet, rice, teff, wheat, and barley, causing significant agricultural damage. Quelas are capable of forming enormous nomadic flocks or super-colonies, sometimes numbering in the millions, which can consume vast quantities of grain daily for instance, a flock of two million birds can eat up to 50 tonnes of grain in a single day (Buba, 2023).

In Country like Ethiopia, red-billed quela outbreaks coincide with rainy seasons and crop maturation periods, leading to devastating impacts on staple crops that are vital for food security and livelihoods. The outbreaks progress along the Rift Valley, causing serious damage to rain-fed cereals such as teff, wheat, sorghum, and barley. Ethiopia has experienced massive quela invasions threatening sorghum, millet and wheat fields, exacerbating food insecurity in vulnerable farming communities (Alene Arega 2010).

Farmers employ various control measures ranging from cultural practices like adjusting planting, harvesting schedules to physical barriers, scaring tactics, mowing. However, the effectiveness of traditional bird preventing methods declines under high

bird pressure, highlighting the need for integrated management strategies that include predictive monitoring, population control, and coordinated area-wide interventions (Ruelle, 1982). According to World Bank (2020), nearly two-thirds of the global poor people live in sub-Saharan Africa and over 80% of Africa's poor population lived in rural areas. In 2018 Smallholder agriculture was identified as the primary economic activity for these populations. Consequently, improving the productivity of African smallholders has been a long standing focus of global development policy (Suri and Udry, 2022).

According to different literature, 80 to 85% of Ethiopian population dwelling in rural area by live of different aggro climatic classification based on agricultural economic activities which contributed 80% GDP of the nation. Smallholder intensive farming system produce more than 90 percent of the agricultural productivity and cultivate more than 90% of the total cropped land (FAO, 2015).

In Ethiopia, sorghum is a major staple food crop, ranking second after maize in total production. It ranks third after wheat and maize in productivity per hectare, and after tef and maize in area cultivated. It is grown in almost all regions, covering a total land area of 1.8 million hactare. Wortmann , (2006) reported that drought, low soil fertility (nutrient deficiencies), insect stem borers, insect shoot fly, quelea birds, Striga and weeds were recognised as major production constraints affecting sorghum in eastern Africa.

In Ethiopia there are different types of crop agricultural in different agro ecological zone of climatic classification. Cereal crops are the dominant one, which includes teff, maize, sorghum; barley, wheat etc. Barley and wheat are the dominant crop that growing in high lands of Arsi and Bale, maize is the dominant crop that growing in west parts of Oromia regional state, Teff is the dominant of cereal crop that grow in Shewa zone Oromia regional state and gojjam zone of Amara regional state while sorghum is the dominant crop that grow in low land parts of Ethiopians (Getachow Sime, 2020).

In much Kola area sorghum are highly vulnerable to this species of birds. So that, agricultural management and concerned body is responsible for its managing and controlling the impacts of this bird on sorghum yield. Currently, control methods used to overcome or minimize the problem are using both modern and traditional methods. Hence the purpose of this study is to assess the impacts of *quela queda* birds on cereal crop specifically on sorghum in kola kebele of Merti Woreda.

1.2. Statement of the problem

Nearly 80% of Ethiopians population relies on agricultural economic activity particularly on cereal crop production, however the productivity is still very low. One of the major reasons for this low productivity is damage of crop by both resident and migratory birds. One of the migratory birds that damage crop throughout in the history of Ethiopian agriculture is *Quela queda* birds. The bird damage to cereal crop has been chronic problem to Ethiopian farmer especially kola zone of Ethiopia on sorghum. The damage caused by Red billed quela was not only the phenomena of Ethiopia but experienced in other part of the world (Nyssen *et al.*2011).

According to Sharma *et al.*(2017) the amount of yield damaged by migratory pest occurrence is obvious. Despite, the fact that the quantity of yield losses attribute to damage by birds under farmer production condition has not been clearly known. Nevertheless, it is assumed that the annual pre and post-harvest, sorghum crop losses due to this birds reaches 50% in Ethiopia.

In Ethiopia, particularly Oromia regional state Arsi zone kola, agro climatic classification study on sorghum crop product and impact caused by *Quela queda* bird is not common. However different study where conducted on different topic in different parts of the country rather than the impact of *Quela queda* on cereal crop product particularly on sorghum. For example the precise consult international(2012) examined about the way of overcoming problem of birds, in addition to this Nyssen *et al* (2011) study on traditional method of migratory bird management technique practiced by small holder farming system. So that, the study is conducted to fill the existed above mention gap

Because of increasing the number of population, today the demands and price of cereal crop specifically sorghum is increasing. but, the production and productivity

become lowering and lowering. In the study area, the yield of sorghum/land deteriorating (reduced) from year to year. Many peasants are shifting the previous land production of sorghum crop to other types of crop production. The motivation and willingness of small holder farming system to produce this crops today are lower than previous year. The food insecurity is steadily become the major problem in the study area. Some peasant lands that previously harvested the sorghum, now steadily shifted to other types of cereal crop or fallowed. Hence the interest is arose to investigate reason and to answering the problem of identification and forward possible recommendation for the problem under investigation.

1.3 Objectives of the study

1.3.1.General objective

The general objectives of the study is to assess the level of impact of Quela birds on sorghum products in Merti woreda, Arsi zone Oromia region, Ethiopia

1.3.2. Specific Objectives

The specific objectives of this study are to:

- examine the level of crop damage by Quela in the study area
- assess the seasonal effects of Quela on the crop
- assess control methods of crop damage

1.4. Research question

Used to achieve research purposes

1. What is the level of crop damage by quela in the study area?
2. In which season crop are lost by Quela?
3. What are the control methods of crop damage provided to the farmer in the woreda?

1.5. Significance of the study

It is believed that the studies will be important to solve the impact of Red billed quela on agricultural yield. The study is also important for agricultural society and agricultural office by build them with knowledge and practice to minimize the problem of Red billed quela on crop yield. I believed that the finding of study is important for improving the life of individual house hold, society and population by minimizing the problem and improving agrarian yield in study area as particularly and overall country as a whole.

The study will be used as a guideline or a point of reference for other researcher especially those who want to study on the same topic in other area.

CHAPTER TWO

REVIEW OF LITERATURE

2.1 The Red-billed Quela (*Quela quela*)

The red-billed quelea (*Quela quela*) is a small granivorous bird belonging to the family Ploceidae (weaver birds). It is confined to semi-arid grasslands and savannas interspersed with woodlands across more than 25 countries south of the Sahara. It is regarded as the most abundant land bird in the world, with populations estimated in the billions (Erickson, 1989; Cheke et al., 2012).

Red-billed quelea are highly gregarious, forming enormous flocks for feeding, as well as large breeding colonies and roosting sites, which may number from thousands to several million individuals. Their dependence on grass seeds as a staple food means that, when natural food resources are scarce or difficult to access, they readily switch to cultivated crops. This makes them one of the most destructive avian pests in sub-Saharan Africa, particularly of small-grain cereals such as sorghum, wheat, millet, rice, barley, teff, and oats (Elliott, 1989; Cheke et al., 2012).

Efforts to control quelea populations in Africa have been ongoing for more than four decades. However, damage to crops has intensified in recent years due to significant changes in land use. The expansion of mechanized farming, coupled with intensified and diversified crop production, has reduced natural grassland habitats while simultaneously creating vast areas of irrigated and rain-fed farmland that provide abundant new feeding grounds. Consequently, quelea colonies are increasingly found in close proximity to croplands, leading to severe and recurrent crop damage (Elliott, 1989; Cheke et al., 2012)



Figure 1 Red billed quela

(Photo by Mustefa Abadir, 2025)

2.2.Distribution and Habitat of the Red-Billed Quela Birds

The red-billed quela (*Quela quela*) is widely distributed across sub-Saharan Africa, occurring in countries such as Senegal, Niger, Chad, Central African Republic, Sudan, South Sudan, Ethiopia, Eritrea, Somalia, Democratic Republic of Congo, Kenya, Tanzania, Zambia, Zimbabwe, Angola, Malawi, Mozambique, Namibia, South Africa, Uganda, Rwanda, and Burundi (Manikowski et al., 1989; Cheke et al., 2012). In Kenya, quela-prone counties include Meru, Laikipia, Nakuru, UasinGishu, Busia, Siaya, Kisumu, Migori, Narok, Kirinyaga, Kitui, Machakos, and Makueni.

The species is closely associated with grass-steppe, dry savanna, and montane-grassland zones, where specific ecological conditions favor its survival. Optimal breeding occurs in areas with annual rainfall of 300–800 mm, in wide open plains and valleys. However, quela generally avoid high-altitude mountains, dense rainforests, and moist savannas bordering tropical forests (Cheke et al., 2012).

Suitable habitats are characterized by Grasses producing small seeds in high quantities, particularly annual wild grasses such as guinea grass. Shrubs, reeds, and acacia trees that provide nesting and roosting sites. Water sources, such as slow-moving rivers, lakes, or stagnant pools, which are essential for daily drinking. The species is usually found within 30 km of water bodies. Red-billed quela tend to avoid closed-canopy forests, including miombo woodlands and the equatorial rainforests of Central Africa. They are also generally absent from the western parts of South Africa and the arid coastal regions of Namibia and Angola. Although they are occasionally observed at altitudes up to 3,000 m above sea level, they are more commonly found below 1,500 m (Manikowski et al., 2012).

2.3 Breeding Biology

The breeding season of the red-billed quela (*Quela quela*) is closely linked to the availability of high-quality food resources, particularly grass seeds and insects, which are essential for nourishing their young. Breeding colonies vary considerably in size, ranging from just a few hectares to several hundred. Within colonies, nest density can reach between 30 and 1,000 nests per tree, depending on vegetation type, canopy height, and foliage density (Ward, 1971; Cheke et al., 2012).

Quela are monogamous, and the average clutch size is three whitish-blue eggs. Sexual maturity is reached at around 9–12 months of age, with at least one breeding attempt typically made per year. Under favorable ecological conditions, however, they may breed up to three times annually (Ward, 1971).

Nest-building is performed solely by the male and usually takes about two days. Incubation is shared between both sexes and lasts 10–12 days. The fledging period is short: young birds leave the nest at 11–13 days of age, initially perching near the nest site and hopping between branches. By approximately 42 days, juveniles become fully independent and are abandoned by their parents (Cheke et al., 2012).

During the first few days post-hatching, chicks are fed on a mixture of soft grass seeds and insects, including caterpillars, grasshopper nymphs, and beetles. This diet ensures rapid growth during the critical early stages of development. The energetically demanding activities of nest construction, courtship, and egg-laying exert substantial

physiological stress on the adults, often leading to a body weight loss of up to 15% (Ward, 1971).

2.4. Feeding

Red-billed quela (*Quela quela*) are primarily granivorous and depend heavily on wild grasses such as *Sorghum* spp., *Oryza* spp., *Echinochloa* spp., *Panicum* spp., and *Urochloa* spp. When wild seed sources become depleted, they shift to cultivated crops, including wheat (*Triticum* spp.), rice (*Oryza* spp.), millet (*Pennisetum* spp.), teff (*Eragrostis* spp.), and sorghum (*Sorghum vulgare*). Their preference is for small-sized seeds with low tannin content, particularly during the vulnerable milky grain stage (Jarvis & Vernon, 1989; Cheke et al., 2012).

During the breeding season, quela supplement their seed-based diet with insects, which are fed to their nestlings during the first few days of life. Insects consumed include grasshopper nymphs, caterpillars, small beetles, and winged termites. Adults simultaneously exploit cereal heads and grass stems by perching and extracting seeds, with this activity occupying much of the day. In the non-breeding (roosting) season, their feeding strategy shifts slightly, as they collect dry, fallen seeds from the ground. Feeding is concentrated during two main sessions—early in the morning after leaving their roosts, and again in the late afternoon before returning (Jarvis & Vernon, 1989; Cheke et al., 2012)

2.5. Roosting

Once breeding is over, red-billed quelea (*Quelaquela*) typically assemble in large roosting sites, often in acacia trees or dense reeds near water sources. These roosts can contain hundreds, thousands, or even millions of birds. The size and density of roosting populations largely depend on the availability of food and water in the surrounding environment (Grange, 1989).

Roosts are primarily occupied at night, while during the hot daytime hours quela may rest in smaller groups near water bodies. In the early morning, for about 15 minutes, birds leave their night roosts in streams of small flocks to drink before flying

distances of up to 30 km in search of food (Grange, 1989; Cheke et al., 2012). Feeding activity is most intensive in the early morning and late afternoon.

Quela typically drink at least twice a day shortly after leaving their night roosts and again around midday or on their return flight in the evening. They usually return to their night roosts about 45 minutes before dusk, finally settling within the last 20 minutes before dark.

The size of feeding flocks varies considerably, from fewer than one hundred to many thousands of individuals. As the dry season advances and food becomes scarcer, flock sizes tend to increase. Their feeding behavior is highly dynamic: flocks fly in spiral and wave-like formations over feeding grounds, continually shifting shape. A small group that discovers a good food source can quickly attract other groups, swelling into a massive feeding flock within minutes. Conversely, flocks that fail to find food may disperse just as rapidly (Grange, 1989; Cheke et al., 2012).

2.6. Migration

Red-billed queelas (*Quelaquela*) undertake large-scale seasonal migrations in response to rainfall patterns and food availability. At the onset of the wet season, they move away from their dry-season concentration areas toward regions where rain has recently fallen or is about to fall. Prior to migration, the birds accumulate considerable fat reserves to sustain their long flights (Ward, 2000).

The timing and direction of their movements are closely linked to the slow seasonal shift of the Inter-Tropical Convergence Zone (ITCZ), which drives rainfall patterns across the African continent. This results in regional differences in the availability of grass seeds and small grains, their preferred food source (Cheke et al., 2012). Consequently, queelas migrate north and south of the equator in search of feeding grounds.

During these migrations, individuals in breeding condition may stop to form large colonies wherever suitable ecological conditions exist. Typically, birds that breed in the early-rainfall zones continue migrating along advancing rain fronts, exploiting new areas of seeding grasses, and may attempt to breed multiple times within the

same rainy seasonsometimes hundreds of kilometers apart (Ward, 2000; Cheke et al., 2012).

2.7. Damage Caused by the Red-Billed Quela Birds

The red-billed quela (*Quela quela*), often referred to as the "feathered locust," is one of the most destructive avian pests of cereal crops in sub-Saharan Africa. In many regions, there are usually two growing seasons per year, and the losses can be substantial if the birds are not controlled. The price of a kilogram of paddy rice was 0.7 USD, making crop damage by quela birds a significant economic concern for smallholder farmers. (Kenya National Bureau of Statistics, 2024)

Damage by birds can be recognized by broken seeds left on the heads and husks scattered on the ground. At the milky stage of grain development, damaged grains appear shriveled with a whitish deposit outside the glumes, resulting from the birds pinching the seeds with their beaks. For crops with smaller seed sizes such as sorghum the entire grain is often consumed (Manikowski&Bruggers, 1991).

Quela is capable of causing serious damage to cultivated crops. An individual quela can eat 3-5g of grain per day and waste a lot more on the ground by its feeding activity. As a result, total damage by an individual bird can reach 7-10g of grain in a day (CABI, digital library). Thus, one million birds, which is a relatively small number in a single roost, can destroy up to 10 tons of 7-10 g of grain a day. This is equivalent to a monetary loss of USD 800,000 per day if the birds are feeding on rice and given that the grain filling and hardening period for grains is 30 about days, it translates into a loss of (185000 USD) in a single season.

2.8.Traditional Approaches for Protecting Cereal Crops from Birds

Many of the techniques frequently are mentioned in discussions of African bird pest problems (Park 1974, Funmilayo and Akande 1979), but only with general comments concerning their effectiveness. Two general approaches are used in African countries to reduce cereal losses to birds: population- suppression techniques including aerial and terrestrial avicidal applications, explosives, and manual nest destruction; and

crop-protection techniques including bird scarers, chemical repellents, protective nets, and agricultural practice modifications.

Avicidal applications and explosives techniques are employed by national or regional crop protection units, traditional nest destruction and bird-scaring methods by individual farmers, and repellents, nets, and agricultural modification methods, experimentally (at least initially) by research scientists (DaCamara-Smeets and Manikowski (1975). Within these categories, farmers in different parts of Africa have developed ingenious methods for dissuading pest birds from their fields.

Local knowledge is consistent with earlier studies showing that farmers often use indigenous coping strategies in the absence of effective institutional interventions (Warren, 1991). These traditional methods include many visual or oratory frightening or scaring techniques (vocalizations, rattles, whip-cracking, slings, flags, shooting), barriers (cloth or natural vegetation covers for ripening heads), agronomic planting or harvesting modifications (crop calendar changes, less susceptible varieties), and bird population suppression (nest destruction, nestling removal, poison baiting). Under many circumstances, bird scarers can reduce damage. Bird scarers usually are positioned in the middle of a field, often on a platform from where they shout, throw rocks or plant stems, and crack whips or rattle cans as birds enter the field. Noise-making objects (cans or calabas gourds) often are attached to lines of cord stretching from this central location throughout the field.

By tugging on the cord, a scarer can cover a larger area. In Gambia during 1979, damage averaged only 2.9% in a field of millet in which a network of rattles was used to scare birds. Contrastingly, damage in a similar size plot without rattles was 10.6%. Losses ranged from 17% to 38% in five other fields on the farm in which no bird scaring occurred.

DaCamara-Smeets and Manikowski (1975) observed differences of 4% and 35% between guarded and nonguarded sorghum fields in Chad. Similar observations were noted on rice in Chad and Benin damage was invariably less in guarded than unguarded fields. However, the success of the traditional methods, particularly scaring or frightening techniques, is subject to many variables, including the time of

year, type and stage of the crop, pest species and its abundance, size and ownership of the field, and diligence of the bird scarers.

2.9. Type and stage of crop damaged

In Nigeria, quela, the most abundant bird pest in Africa, are reported to prefer small seed (Ward 1965). In cage studies, seeds of 8-15 mg have been preferred (Manikowski and DaCamara-Smeets 1979), which correspond to the size of millet, rice, and sorghum. Millet and rice often are the most severely attacked cereals and are eaten throughout their maturation period (milk to hard-dough stages). Sorghum which is the primary crop with millet in the Sahelian countries (the range of quela) often is heavily damaged, but usually during the early stages (milk and soft-dough) when it is squeezed from between the glumes.

In both Nigeria (Ward 1965) and Ethiopia (Erickson 1979), cultivated grains, particularly sorghum, are important food items of quela. Pest species and abundance. Small cereal grains also are eaten by other species of pest birds, many of which weigh only 12-20 g, and often are extremely numerous. These species include quelea, sparrows, bishops (*Euplectes* spp.), *Ploceus* weavers, and mannikins (*Lonchura* spp.). Damage to maize, which has a larger grain and a protective husk, is, however, almost entirely caused by village weavers (*Ploceuscucullatus*), buffalo weavers (*Bubalornis albirostris*), starlings (*Lamprolornis* spp.), doves (*Streptopelia* spp.) and long-tailed parakeets (*Psittaculakrameri*). Pest populations of these species are smaller and more dispersed so that damage attributed strictly to them seldom exceeds >5% on large schemes.

CHAPTER THREE

MATERIAL AND METHODS

3.1 Description of the study area

Merti woreda is one of 25 woreda in Arsi Zone of Oromia Region (Fig 1). Merti is situated at about 189.5 km south east of Addis Ababa. According to relative location the woreda is found in the West of Jeju, in the North West of east Shewa in the East Asako, in the South East of Guna woreda respectively. According to absolute location it lies between 08°23'N to 08°43'N of latitude and 39°50'E' to 40°0'E of longitude. Merti woreda is found in eastern tip of Arsi Zone and its' administrative town. For administration purposes Merti is divided into 23 kebeles. A kebele is the smallest unit of administrative structure. The woreda covers a total area of 2173 km² and it has 19 rural kebeles and 4 urban kebeles. With regard to land use, the largest area (38%) of the woreda is intensively cultivated for annual crops mainly sorghum, teff, wheat and barley, 27% is covered with forest, 14% is a grazing land, 9% is covered by others and the remaining 12% is uncultivable land (Merti woreda Administrative office, 2023).

According to traditional agro climatic classifications of Ethiopia, the woreda is found Weinadega and Kola zone of climatic classification. The rainfall pattern is most often bimodal but sometimes monomodal. The annual average rainfall in the study districts ranges from 750 to 1500 mm, the maximum having been recorded at (1250 mm) and the minimum at 500 mm). The yearly average temperature ranges between 20⁰ to 25°C and 10⁰- 15⁰C (From the above, one can assume that the study areas receive sufficient rainfall to support cereal crop production).

In addition rain fed agriculture mainly cereal cropping along with livestock rearing is the major source of food and income for maintaining the livelihoods. Barley and wheat are the main crops in the highlands and midlands (Weinadega) and Millet or Sorghum is lowlands with restricted inter cropping opportunities due to poor soil composition. (MWAO 2023)

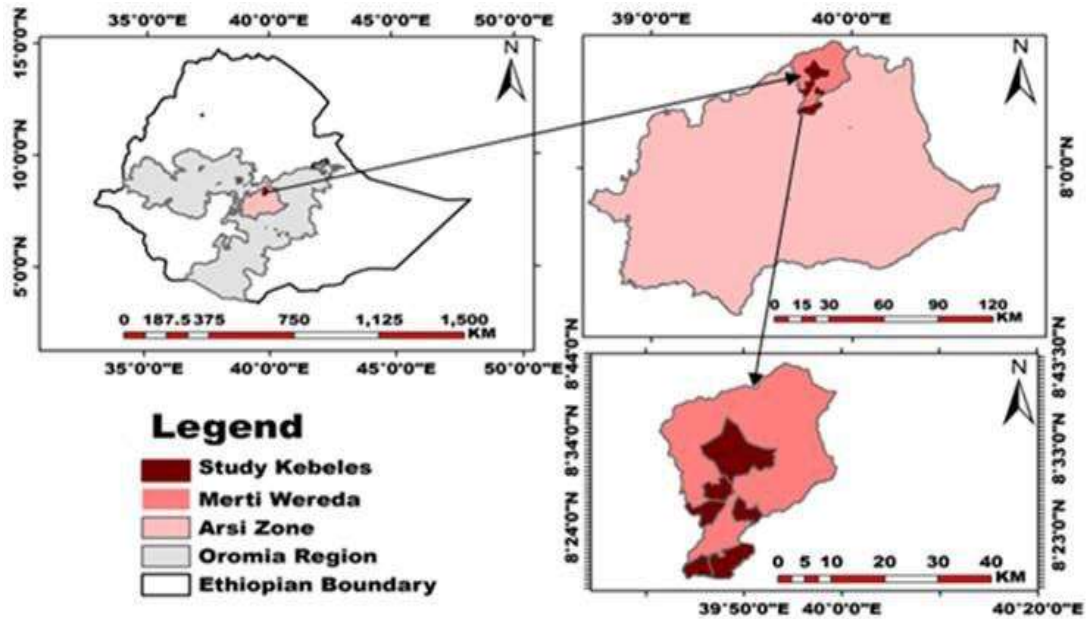


Figure 2 Map of the Study Area

3.2.Data collection

The study employed both primary and secondary data sources. The primary data sources was gathered through close ended structural written questioners prepared to 100 representative respondents. In addition to this personal survey observation during harvesting season was be employ as a primary source to know the opinion of farmer.

3.2.1. Population, Sample Size and Sampling Technique

Merti Woreda consists of 19 rural and 4 urban kebeles. Among the rural kebeles, five (20%) are classified as kola (lowland) and are located south of Merti town. For this study, three kola kebeles Dembeka, Waterodino, and Otichadole were purposively selected. The combined population of these kebeles is 2,803 individuals (2,551 males and 252 females). Stratified proportional sampling was selected to ensure that the study population was adequately represented across both kebeles and sex categories. Since the population sizes of the selected kebeles and the male-to-female ratios varied, proportional allocation minimized sampling bias and enhanced representativeness. The sample size was determined using Cochran's single population proportion formula with finite population correction after Initial sample size (infinite population): $n_o = \frac{Z^2 pq}{e^2}$ is calculated at 95% confidence ($Z=1.96$) for p and $q=0.5$ with margin of error 9.6 allowed then $n_o = 0.9604 / 0.00927369 = 104$ finally the sample size was determined as finite population correction (FPC): $n = \frac{n_o}{1 + \frac{n_o - 1}{N}} = \frac{104}{1.036} = 100$.

Therefore the sample size of the population $n=100$ is used for the next procedure. Proportional allocation ensured that the distribution of the sample reflected the actual population structure both by kebele and by sex.

Total population and sample:

Total population $N=1317+840+646=2803$ and Total sample $n=47+30+23=100$

Proportional allocation by kebele:

Dembeka: population share $=1317/2803=0.46985$ and sample share $=47/100=0.47$

Waterodino: population share $=840/2803=0.29968$ and sample share $=30/100=0.30$

Otichadole: population share $=646/2803=0.23047$ and sample share $=23/100=0.23$

The sample shares equal the population shares (to rounding), so allocation across kebeles was proportional.

Proportional allocation by sex within each kebele:

Dembeka: male pop $=1117/1317=0.8886$ and male sample $=42/47=0.8936$

Waterodino: male pop $=756/840=0.9000$ and male sample $=27/30=0.9000$

Otichadole: male pop $=618/646=0.9567$ and male sample $=22/23=0.9565$

The table below has shown that the way how the sampled study participants was selected proportionally from each stratum. After having the numbers of study participants, the exact households was taken from the name list (Sample frame) using stratified sampling technique.

Table 1 Summary of population and sample size in the research area

kebele	Study population			Sample size		
	Male	Female	Total	Male	Female	Total
Dembeka	1117	140	1317	42	5	47
Waterodino	756	84	840	27	3	30
Otichadole	618	28	646	22	1	23
Total	2491	252	2803	91	9	100

Source : mertiworeda administration office(2023)

3.2.2 Questionnaire

To gather information from representative respondents through questioners, close ended structural written question were organized and prepared to the respondents. The questioners was state clear introduction and objective of the study and purpose of the research.

3.3 Data Analysis

The result organized by tabular and was presented by frequency and percentage. Descriptive statistical methods such as percentages and frequency were employed to analyze and summarize the data on impact of quelaquela on agricultural product. The most usefull information gathered by local people was analyzed through descriptive statistics. To make simple calculation and to draw graphs MS Excel spread sheet was utilized.

CHAPTER FOUR

RESULTS

4.1.Demographic characteristics

As shown in Table 2, the survey showed that most of the respondents were males (91%) while 9% respondents were female.

In addition, most of the respondents were between the age of 25 to 35 years (32%) while 25% between 36 to 45 years old, 30% of respondents were between 46 to 55 years. 10% of the respondents were at age above 55 years and the remained 3% do not know their age .

Concerning about educational backgrounds of respondents, most of respondents were complete primary school(52%) and 20% of them completes secondary school in addition to this 8% of respondents reply that illiterate (unable to read and write),15% of them replied that complete adult educational program. Regarding about marital status of household in the study area,the survey showed that most of the respondents were married(80%) and 6% were both single and divorce, additionally 8% were widow.

The survey about occupation showed that most of the respondents were (60%) engage mix farming(rearing of animal in one way and production of crop on other way),25% of them rely on only crop production, 5% of them pure pastoralist, 6% of them daily labor and 4% of them were rely on other work.

Most of the respondents regarding duration of settlement in the study area were above 31years(35%), in between of 21 to 30 years were 30% and 20% were between of 11 to 20 years and the least 15% of them were 1 to 10 years.

Based on the family size of respondents most of them have 6 to 10 family size (40%) while 32% of them have 1 to 5 additionally 15% were 11 to 15 and 13% were a family size above 16(table 2)

Table 2 Demographic characteristics of representative respondents

Items	Alternative	Respondents response	
		frequency	Percentage
Sex	A Male	91	91%
	B Female	9	9%
	Total	100	100%
Age	A.25-35	32	32%
	B.36-45	25	25%
	C.46-55	30	30%
	D.above 56	10	10%
	E.none	3	3%
	Total	100	100%
Level of your education	A.illiterate	8	8%
	B.completed adult education	15	15%
	C.primarily school	52	52%
	D.complete secondary school	20	20%
	E.higher education	5	5%
	Total	100	100%
Marital status	A.Single	6	6%
	B.Married	80	80%
	C.Divorce	6	6%
	D.Widowed	8	8%
	Total	100	100%
Occupation	A.mixed farm	60	60%
	B.crop production	25	25%
	C.rearing animals	5	5%
	D.daily labour	6	6%
	E.others	4	4%
	Total	100	100%

Years of live in the study kebele	A.1 to 10 years	15	15%
	B.11 to 20 years	20	20%
	C.21 to 30 years	30	30%
	D.above 31	35	35%
	Total	100	100%
Number of family members	A.1 to 5	32	32%
	B.6 to 10	40	40%
	C.11 to 15	15	15%
	D.above 16	13	13%
	Total	100	100%

4.2. Economic Activity

The survey results show that most farmers hold relatively small plots of land. About 48% of the respondents own between 1 to 2 hectares, followed by 36% who have 0.5 to 1 hectare, 10% with 3 to 5 hectares, and only 6% possessing more than 5 hectares. In terms of productivity, the majority of farmers (65%) reported an annual crop yield of 11 to 15 quintals, while 13% produce 6 to 10 quintals, 12% produce only 1 to 5 quintals, and 10% achieve more than 16 quintals. This indicates that while most farmers have small to medium landholdings, the overall yield is concentrated in the range of 11 to 15 quintals per year (Table 3).

Table 3 Economic Activity of respondents

Item	Alternative	Respondants response	
		frequency	Percentage
Land in hectare	A. 0.5 to 1	36	36%
	B. 1 to 2	48	48%
	C. 3 to 5	10	10%
	D. above 5 hec	6	6%
	Total	100	100%
Annual crop yield in quintal	A. 1 to 5	12	12%
	B. 6 to 10	13	13%

	C. 11 to 15	65	65%
	D. above 16	10	10%
	Total	100	100

(Source: From respondents response of the study area)

4.3. Type of crop cultivated and yield

In the previous year, sorghum was the most cultivated cereal crop, making up 51% of the total cultivation. This was followed by teff at 22%, maize at 13%, barley at 8%, and other crops at 6%. However, the current year shows a clear shift in cultivation patterns, with teff becoming the most widely grown crop, accounting for 67% because of teff is not mostly affected by the migratory birds. Maize follows with 15%, barley with 10%, sorghum with only 6%, and other crops with 2% (Table 4).

Table 4 Types of crop cultivated and yield

items	alternative	Responses of respondents	
		frequency	percentage
Most cultivated crop in previous year	A.Sorghum	51	51%
	B.Maize	13	13%
	C.Teff	22	22%
	D.Barely	8	8%
	E.Other	6	6%
	Total	100	100
Most cultivated crop currently	A.teff	67	67%
	B.maize	15	15%
	C.sorghum	6	6%
	D.barely	10	10%
	E.other	2	2%
	Total	100	100

4.4.Reasons of low productivity

The major reason farmers leave their land fallow is the impact of migratory birds, which accounts for 44% of the responses due to cultivating sorghum on farm lands is damaged by birds. This is followed by unpredictable weather conditions (27%), the presence of induced plant species (17%), and low yield per land ratio (12%) (Table 5). Regarding crop harvesting, farmers reported that in their environment, crops can only be harvested during the autumn season, representing 100% of the responses, while no harvesting occurs in summer, winter, or spring. Similarly, migratory and seasonal birds also arrive exclusively during autumn.(table 5)

Table 5 Response of respondents on reasons of low productivity

items	alternative	Respondants response	
		Frequence	percentage
Reason to fallow land	A.impact of migratory bird	44	44%
	B.Unpredictable weather condition	27	27%
	C.low yield per land ratio	12	12%
	D.because of induced plant species	17	17%
	T.	100	100
Season of crop harvested	A.Summer	0	0%
	B.Winter	0	0%
	C.Autumn	100	100%
	D.spring	0	0%
	T.	100	100%
Seasons of migratory birds arrive	A.Summer	0	0%
	B.Winter	0	0%
	C.Autumn	100	100%
	D.Spring	0	0%
	T.		100%

4.5.Effect of Quela on agricultural productivity cereal crops

The impact of Quelaquela birds on crops is reported to be extremely severe, with 80% of respondents indicating a very high impact and 20% reporting a high impact, while none considered the damage medium or low (Table 6). Among the cereal crops, sorghum is the most affected, with 85% of respondents stating that it experiences the greatest yield reduction due to these birds. Teff follows with 10% and barley with 5%, while maize is not reported to be affected at all.(table 6)

Table 6 Effect of red billed quela on the productivity

Items	Alternative	Respondents response	
		Frequency	percentage
Impact of <i>Quela quela</i> birds on crop	A. very high	80	80%
	B. high	20	20%
	C. medium	0	0%
	D. low	0	0%
	Total	100	100%
Mostly damage crop by quela birds	A. sorghum	85	85%
	B. maize	0	0%
	C. teff	10	10%
	D. barely	5	5%
	Total	100	100%

4.6.Methods of quela control

The findings presented in Table 8 highlight the different methods used to control the impact of Quela birds on crop production in the study area. Results show that organizational and institutional efforts to prevent or minimize the damage caused by these birds are perceived as weak, with 63% of respondents rating the measures as low and only 7% (3% very high and 4% high) perceiving them as strong. Similarly, government interventions were found to be relatively moderate, where 30% rated the measures as medium, 30% as low, while only 40% (15% very high and 25% high) acknowledged stronger actions. On the other hand, agricultural extension services were evaluated more positively compared to government and institutional support, as 54% of respondents rated their contribution as high or very high, although 31% still considered it medium and 15% low.

About 67% of respondents rated traditional control measures as very high or high, while only a small fraction (10%) viewed them as less effective. Among the traditional techniques applied, a large majority (70%) reported using all available methods in combination, while scaring birds (15%), mowing (10%), and the local practice known as *Babaqu* or *forming line* (5%) were also mentioned as specific strategies. (7)

Table 7 Methods of quela control

Items	Alternative	Respondants response	
		Frequence	Percentage
Measure taken by organization and institution	A. high	7	7%
	B. medium	30	30%
	C. Low	63	63
	Total	100	100%
Measure taken by government	A.very high	15	15%
	B. high	25	25%
	C.medium	30	30%
	D. low	30	30%
	Total	100	100%
Measure taken by agricultural extension	A.very high	17	17%
	B.high	37	37%
	C. medium	31	31%
	D. Low	15	15%
	Total	100	100%
Traditional method used for controlling	A.very high	37	37%
	B. high	30	30%
	C.medium	23	23%
	D. low	10	10
	Total	100	100%
Traditional technique used	A.Mowing	10	10%
	B.Babaqu	5	5%
	C.Scarring	15	15%
	D.All method	70	70%
	Total	100	100%

CHAPTER FIVE

5. DISCUSSION

The survey showed that most of the respondents were males as large number of farmer were male. It also show that most farmers hold relatively small plots of land between 1 to 2 hectares with an annual crop yield of 11 to 15 quintals showing moderate productivity levels. According to Sharma et al.(2017) revealed in his work, the amount of yield damaged by migratory pest occurrence is obvious. Sorghum was the most cultivated cereal crop, making up 51% of the total cultivation. However, while sorghum was dominant in the past year during the bird is not adapted to damage, farmers have now shifted their focus toward teff cultivation. The major reason farmers leave their land fallow is the impact of seasonal and migratory birds, which accounts for 44% of the responses. Similar crop shifts in response to red billed quela have been documented in other smallholder contexts (FAO, 2015).

The farmers harvest crops during the autumn season and migratory and seasonal birds also arrive exclusively during autumn which strongly influences farming practices and productivity. The effect of these birds on crops is reported to be extremely severe, with 80% of respondents indicating a very high impact and sorghum is the most affected, with 85% of respondents stating that it experiences the greatest yield reduction due to these birds. This clearly shows that Quelaquela birds pose a serious threat to sorghum production, making it the most vulnerable crop in the area. This aligns with previous research that identifies the red-billed quelea (*Quela quela*) as one of the most destructive avian pests of cereal crops in Africa, particularly sorghum and millet (Elliott, 1989, Cheke & Garms, 2013).

Concerning quela control, organizational and institutional efforts to prevent or minimize the damage caused by these birds are weak and hence stronger actions are needed. On the other hand, agricultural extension services had more positive impact compared to government and other institutional support. In contrast, traditional methods were found to be the most significant and widely practiced means of minimizing bird damage. Most of the respondents (70%) reported using all available traditional methods in combination including scaring, mowing, and the local practice known as *Babaqu or space forming* Nyssen J et al (2011). Such reliance on local

knowledge is consistent with earlier studies showing that farmers often use indigenous coping strategies in the absence of effective institutional interventions (Warren, 1991). This suggests that, due to weak institutional and government support, farmers mainly rely on indigenous knowledge and locally available methods to protect their crops. Overall, the results indicate that enhancing government and institutional interventions, while integrating and strengthening traditional techniques, could provide a more sustainable and effective approach to controlling Quela bird infestations and thereby improving crop productivity in the study area.

CHAPTER SIX

CONCLUSSION AND RECOMENDATOION

6.1 Conclusion

The impact of Quela birds on agriculture, particularly on sorghum, is significant and often detrimental. *Quela quela*, the red-billed quela, is recognized as a major agricultural pest in Africa, capable of causing severe damage to sorghum crops. These birds tend to attack sorghum especially when their natural food sources become scarce, targeting traditional grains during critical growth stages such as maturity and breeding seasons. The impact of Quela varies with environmental factors, availability of natural food sources, cropping patterns and rainfall, which influence bird movement and feeding behavior. When wild seeds become scarce, Quela birds increasingly target cultivated sorghum, intensifying risks for farmers and kebeles food supplies. Understanding the ecology and foraging patterns of Quela is therefore critical for optimizing timing and methods of control. This leads to substantial crop losses that threaten food security and farmers' livelihoods in the area. The high population density and large flock sizes of these birds enable them to inflict severe damage, sometimes wiping out entire fields within hours. This leading to substantial economic losses and threatening food security in affected regions similarly in Merti woreda of kola kebele the study revealed that *Quela quela* birds pose a severe threat to agricultural productivity particularly to sorghum cultivation. Sorghum, once the most widely grown crop, has drastically declined in favor of teff due to repeated and devastating damage from quela flocks. Over 80% of farmers reported experiencing very high yield losses, with sorghum being the most affected cereal (85%). Quela birds affect sorghum production and cause severe damage. .Tradational methods such as mowing and scaring offers promising avenues for sustainable management of Quela populations, ultimately helping to protect sorghum production and enhance food security in affected regions. Effective and regular damage assessment and control initiatives remain critical components of minimizing Quela related losses in sorghum cultivation.

6.2 Recommendation

Quela birds are known to cause significant pre-harvest damage to sorghum in Mertiworda notably in kebeles like Dembeka, waterodino, otticha dole sometimes leading to severe losses that affect food security and farmer livelihoods. The researcher recommended as follow

- Increase coordinated action at woreda and regional levels to control quela birds, including timely surveillance and preventive measures during breeding and migratory seasons.
- Establish community-based early warning systems for bird invasion and link them with agricultural offices for rapid response.
- Enhance Traditional Control Methods
- Recognize and strengthen effective indigenous practices such as scaring and mowing by integrating them with modern technologies (e.g., acoustic devices, netting).
- Promote Irrigation and Crop Diversification
- Encourage cultivation of less bird-sensitive crops alongside sorghum to balance food security needs
- Strengthen extension services to provide practical knowledge on bird management, improved agronomic practices, and sorghum irrigation techniques.
- Support applied research on sustainable quelea control methods, such as biological controls or habitat management.
- Introduce mobile-based platforms for farmers to report bird infestations and receive real-time advice.

6. REFERENCE

- Alene Arega. 2010. *Productivity growth and the effects of R&D in African agriculture*. Agricultural Economics 41, 223–238.
- Australian Bureau of Statistics. 2008. *Agricultural production and damage statistics*.
- Buba, Z.M., Sabastian M.M., & Ussa, J. 2023. *Evaluation of the food of red-billed quela (Quela quela) during cropping season in Gyawana and environs, Adamawa State, Nigeria*.
- CABI Digital Library. *Quelea bird grain damage estimates*.
- Cheke, R.A, Elliott C and Allan, R.F (2012). *Red-billed quelea ecology and pest status in Africa*.
- Elliott, C.C.H. 1989. *The pest status of the quelea*. In: *Quelea quelea: Africa's Bird Pest* [ed. by Bruggers, R.L. & Elliott, C.C.H.]. Oxford University Press.
- Erickson, W.A. 1989. *Quelea quelea*. In: *Africa's Bird Pest* [ed. by Bruggers, R.L. & Elliott, C.C.H.]. Oxford University Press.
- Erickson, W.A. 1979. *Cultivated grains in Ethiopia as food items of quelea*.
- FAO. 2015. *Sorghum and Millets in Africa*. Food and Agriculture Organization of the United Nations.
- Funmilayo, O. & Akande, S.O. 1979. *Bird damage and control methods in African cereal fields*.
- Getachow Sime. 2020. *Agricultural crop distribution in Ethiopia*.
- Grange, M.L. 1989. *Social behaviour and vegetation preferences of queleas during roosting*. In: *Africa's Feathered Locust*. Harare: Baobab Books.
- Ibsa Dawid & Feysal Mohammed. 2021. *Red-billed quelea crop damage and economic impact in Ethiopia*.
- Jarvis, M.J.F. & Vernon, C.J. 1989. *Food and feeding habits of queleas in southern Africa*. In: *Africa's Feathered Locust*. Harare: Baobab Books.
- Manikowski, S. & Bruggers, R. 1991. *Crop damage by quelea birds in Africa*.
- Manikowski, S. & DaCamara-Smeets, A. 1979. *Seed preferences of quelea in cage studies*.
- Nyssen J, Govaertes B, Deckers J . 2011. *Traditional method of migratory bird management techniques practiced by smallholder farming systems in Ethiopia*.
- Park, P. 1974. *Traditional bird scaring methods in Africa*.

- Precise Consult International. 2012. *Bird pest management and agricultural strategies in Ethiopia*.
- Ruelle, P. 1982. *Traditional approaches for protecting cereal crops from birds in Africa*. OCL AL AV, Dakar, Senegal.
- Sharma, Koonner R, Arora R . 2017. *Migratory pests and yield damage in Ethiopian sorghum production*.
- Suri, T. & Udry, C. 2022. *Productivity of African smallholders and development policy*.
- Ward, P. 1965. *Seed size preference of quelea*.
- Ward, P. 1971. *Breeding biology of the red-billed quelea*.
- Ward, P. 2000. *Migration ecology of the red-billed quelea*.
- Warren, D.M. 1991. *Indigenous knowledge and coping strategies in African agriculture*.
- Wortmann F. 2000. Constraints affecting sorghum
- World Bank. 2020. *Poverty and rural development in Sub-Saharan Africa*.

APPENDICES

ADDISABABA UNIVERSITY COLLEGE OF NATURAL SCIENCES
DEPARTMENT OF BIOLOGY (ECOLOGICAL AND SYSTEMATIC)

The purpose of this questioners is to collect data for the assessment of impacts of *Quelaquela* birds on sorghum yield in kola zone of Mertiworedakebele. It also aimed to identify the amount of sorghum yield reduced from year to year by this bird.

Your genuine concern and willingness in filling the questionnaires will make the study more objective informative and useful. Hence, you are kindly requested to give a genuine and useful answer only for the study purpose.

Instruction: it is not important to write your name on the questioners paper.

Give a short and precise answer for a short answer question give only one answer to the multiple choice answer.

Incircle on selected multiple choice answer

Part 1: Questioners Concerned About The Background of Representative Respondents.

Household survey questionnaire

Date -----

Kebele -----

1. Gender

A. Male B Female

2. Age

A. 25-35 Years C. 36-45 B. 46-55 Years D.Above 56 E.None

3. Level of your education.

A.Illiterate. B. Completed adult educational program. C. Primarlyschoool.
D.Completes secondary school E. Higher education program

4. Marital status.

A. Single B. Married C. Divorced D. Widowed

5. Occupation.

A. Mixed Farm B. crop production C. rearing of animals D. Daily labor E. Other

6. Years of live in the study kebele.

A.1 – 10 years B. 11 – 20 years C. 21-30. D above 31

7. Number of family members.

A. 1-5 B. 6-10 C. 11 -15 D. Above 16

Part 2 Questionary concerned with Socio-economic characteristics of the reperesantative respondents

1. Size of your holding land in hectare?

A. 0.5 to 1 B. 1 to 2 C. 3 to 5 D Above 5 hectare

2. Annual total crop yield in quintal?

A. 1 to 5 B. 6 to 10 C. 11 to 15 D. Above 16

3. In previous year which types of cereal crop mostly you cultivated than other?

A. Sorghum B. Maize C. Teff D. Barley and wheat E. Others

4. Now which types of crops you mostly cultivated on your land?

A. Sorghum B. Maize C. Teff D. Barley and wheat E. Others

5. In previous year from which types of cereal crop you got high yield per land (high yield land ratio) A. Sorghum B. Maize C.Teff D. Barley and wheat E. Others

6. Today which crops probably you cultivated less than the previous year of experience?

A. Sorghum B. Maize C. Teff D. Barley and wheat E. Others

7. Do you have experienced to fallowed your land that previously cultivated sorghum?

A. yes B.no C. no answer

8. Based on question no 7 if your responses are “yes” what is the reason that you fallow your land

A.impact of seasonal and migratory bird B. unpredictable weather condition C. low yield per land ratio D. because of induced plant species that can make high damage of sorghum (aqancara)

9. Which season sorghum crops can harvested in your environment?

A. summer B. winter C. autumn D. Spring

10. Which seasons migratory and seasonal birds can arrive your kebele ?

A. summary B. winter C. autumn D. Spring

11. Impact of *Quelea* birds on sorghum

A. very high B. high C. medium D. low

12. The amount of sorghum yield reduced by *Quelea* birds probably -----
quintal per hectare A. 1 to 5 B. 6 to 10 C. 11 to 15 D. above 16

Part 3. Questionnaire that concerned about alternative option to produce sorghum crop in the study area

1. Is there irrigation water that can be capable of cultivating crop in your environment

A. yes B. no C. no answer

2. based on question no 1 if your answer is “yes” which cereal crop are mostly cultivated through irrigational way in your kebles

A. Teff B. sorghum C. maize D. barely E. other

3. Do you have a land near to potential water which possible to cultivation of sorghum crop?

A. Yes B. no

4. Do you have experience to cultivate sorghum through irrigational way?

A. yes B. no

5. Do you have experience awareness and guidance from agricultural extension services, government body, from any other, who work on agricultural production and productivity?

A. yes B. no

Part 4. Measure taken by farmer, government and any local, national and international institution and organization that who work on agricultural issue to minimize the impacts of *Quelea* birds on sorghum

1. Measure taken by organization and institution to prevent or minimize the impact of *Quelea* birds A. very high B. High C. medium low D. Low

2. Measure taken by government to reduce the impact on the kebele

A. very high B. High C. medium low D. Low

3. Measure taken by agricultural extension services to reduce *Quelea* birds on sorghum crop A. very high B. High C. medium low D. Low

4. Traditional method to control (minimize) the impact of this birds

A. very high B. High C. medium low D. Low

5 Which traditional technique that could applied to reduce the impacts of this birds on sorghum?

A. Mowing B. Seed cleaning C. Hand clamp