Farmers' Perceptions towards Cultural Methods for Control of Maize Weevils *(Sitophilus zeamais)* in Tegeres Sub County, Kapchorwa District

By

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March, 2024

DECLARATION

I CHEMUTAI DEBORAH declare that this report was an original research work in the department of Agriculture, and has not been submitted anywhere for any degree.

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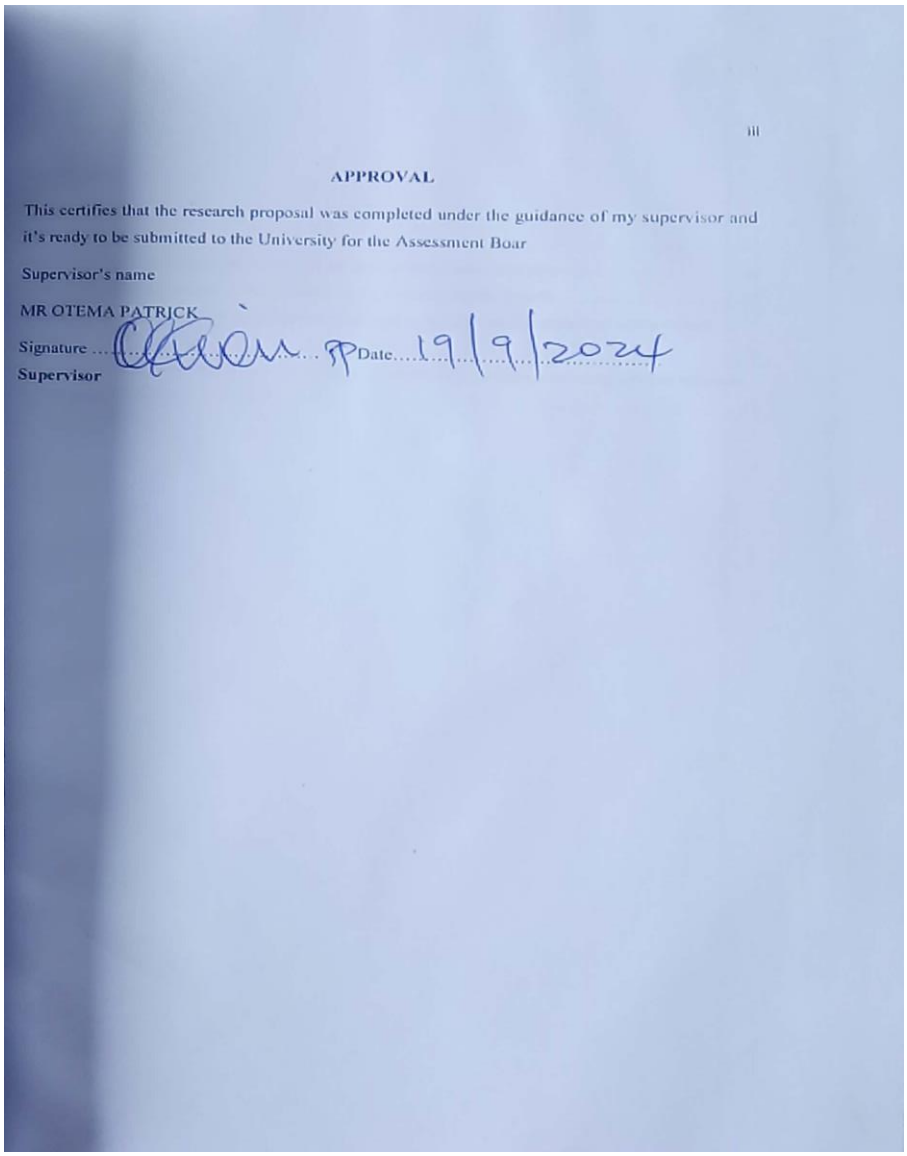
Student

ACKNOWLEDGEMENT

I want to take this opportunity to appreciate all members who were besides me during the course of my research. I want thank God for giving me the opportunity to endure my research process till completion. I want to thank my research supervisor for the support and guidance given to me while executing my research process



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APPROVAL

This certifies that the research proposal was completed under the guidance of my supervisor and it's ready to be submitted to the University for the Assessment Boar

Supervisor's name

MR OTEMA PATRICK

Signature ..... Date 19/9/2024

Supervisor

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LIST OF ABBREVIATIONS

FAO: Food Agricultural Organization

WHO: World Health Organization

IFAD: International For Agricultural Management

WFP: World Food Programme

SSA: Sub Saharan Africa

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EXECUTIVE SUMMARY

The Maize weevils (*Sitophilus zeamais)* was a common harmful pest insect that infested stored food products in the modern world. Although all three species were cosmopolitan insects that caused great damage to human products then, they were thought to be those insects that originated from the forest in the southern foothills of Himalayas, diverged from the same ancestor, and had spread across the old world along with the beginning of agriculture. Maize grain loss in Uganda was estimated to be about 20–40% losses during cultivation and 30–90% post-harvest and storage losses (*Odendo et al., 2001).* The maize weevil was the most common storage pest of maize in Kapchorwa, and especially in the Tegeres sub-county. The specific objectives were: To find out the cultural methods employed when controlling maize weevils by farmers in Tegeres Sub-county, Kapchorwa district, to determine farmer's perceptions towards different cultural methods used to control maize weevils, to assess the challenges faced by farmers in applying cultural methods and to suggest possible solutions to the challenges faced by farmers in applying cultural methods. Some farmers believed that cultural methods, such as properly drying and storing maize produce, effectively controlled maize weevils.

Cultural methods referred to non-chemical control methods such as crop rotation, intercropping, and storage practices. Infestation of maize beetle was reduced by good store hygiene, such as cleaning the store between harvests. While chemical pesticides had been widely used to control maize weevils, their use was often associated with health and environmental concerns.

Researchers had made progress in breeding maize varieties with enhanced resistance to weevil infestations. The researcher was able to use an interview guide as a tool which can enable her to adequately collect data from the field. Cross- sectional analysis was carried out to generate frequency, percentile, mean, median, mode, standard deviation and cumulative frequency

CHAPTER ONE

INTRODUCTION

1.1. Background

The world's population was projected to hit 9 billion by 2050 (*USAID, 2023)* and this required an increase of not just food production but also nutritious food to meet both food and nutrition security *(Plesse, 2020).* In Africa, the agriculture sector was the primary source of food and income. The sector employed 60 percent of the population in Africa *(Zuma, 2020*), making it the main economic activity on the continent *(Oluwatayo & Ojo, 2016)*. Most of the food in Africa was produced by small-scale farmers. However, hunger and undernourishment remained as one of the major challenges faced by small-scale farmers. FAO, IFAD, UNICEF, WFP, and WHO (2019) reported that there were 260 million undernourishment in Africa and 93.3 percent of these were in Sub-Saharan Africa (SSA)*(Steyn, 2019)*. This implied that food production had not kept pace with the increasing population.

The Maize weevils (*Sitophilus zeamais)* was a common harmful pest insect that infested stored food products in the modern world. Although all three species were cosmopolitan insects that caused great damage to human products then, they were thought to be those insects that originated from the forest in the southern foothills of Himalayas, diverged from the same ancestor, and had spread across the old world along with the beginning of agriculture. The global distribution of these insects occurred relatively recently, and they had continued to spread as a result of worldwide cereal trading during the 20th century.

Botanical Description of maize

Maize or corn (*Zea mays*) was a plant belonging to the family of *Poaceae* (*Okonmah and Eruotor, 2012)* as one of the most significant grain crops in the world, it was grown all over the world. In addition to being a staple in animal feed and a vital source of nutrients for humans, maize has also been used to make a wide range of industrial goods, such as corn syrup, starch, maltodextrins, and oil. Lately, it has been utilized as biofuel. Maize was a versatile crop and it was cultivated over a wide range of agro climatic zones. The suitability of maize to diverse environments was unrivalled by any other crop.

Maize weevil description

According to (*Jackson, 2021*), the maize weevil was a small snout beetle which varied in size, averaging about three thirty-second inch in length. It varied from dull red-brown to nearly black and was usually marked on the back with four light reddish or yellowish spots. The maize weevil had fully developed wings beneath its wing covers and could fly readily. The thorax was densely pitted with somewhat irregularly shaped punctures, except for a smooth narrow strip that extended down the middle of the dorsal (top) side. The Curculionidae family of beetles included the maize beetle (*Nwosu, 2018*). It was widespread throughout the world's tropical regions. Maize was severely harmed by this pest. According to (*Jackson, 2021*), this species preyed on both stored grain products and field crops. The corn beetle was between 2.5 and 4 mm long. Four reddish-brown dots might be seen on the wing coverings of this tiny brown beetle. Its antennae were elbowed and it had a long, narrow snout (*Jackson, 2021*),

The life cycle

The average developmental period for this species was thirty-six days. The female created a hole in the maize seeds by eating through their surface. After that, it covered the opening and laid a tiny, oval white egg while removing the ovipositor (*Barcelos, 2012*)

The hole was sealed with a waxy secretion that created a plug(*Yaseen et al., 2019)*. The plug quickly hardened and this provided the only visible evidence that the kernel was infested. Only one egg was laid inside each grain. When the egg hatched into a white, legless grub, it would remain inside the grain and begun to feed on the grain. The larvae would develop to a pupa while inside the grain and would then chew an exit outlet hole and emerged as an adult beetle

Host range

The maize beetle commonly attacked standing crops in particular, maize before harvest, storage. Although the maize beetle could readily breed in finely processed grains, it could easily breed in products such as macaroni and noodles, and milled cereals that had been exposed to excessive moisture.

Damage and detection

Early detection of infestation was difficult. As –zeamais larvae fed on the inside of individual grains. Infested grains contain holes through which adults have emerged. A possible indication of infestation in grain was when they were placed in water and they floated to the surface *(Mason, 2003*). In large stores of grain, an increase in temperature might be detected. The most obvious sign of infestation was the emergence of adults.

1.1.1 Maize Production in Uganda

Maize production systems were dominated by small scale farmers who produced for both consumption and as a source of income. (*Scott, 2021)*According to FAOSTAT (2020), maize production had generally increased for the past decade. The 2018 agricultural survey showed that

production of maize was estimated to be 3.4 million metric tones. This was a remarkable increase compared to 2.3 million metric tones produced in 2009. The production of maize was highly. Maize was one of the most important cultivated staple crops in Uganda. According to recent data, the total area used for crop production in 2018 was 2.5 million hectares, or 21.68 percent, of which was planted with maize(*Kwasakye*, 2022). variable across the country due to the difference in agro-ecological zones and socio-economic conditions*(EMMANUEL, 2022).*

1.1.2 Maize Production in Kapchorwa District

Crop production was the main source of income for small scale farmers in Kapchorwa district (*Aron, 2019).* Due to the nature of the landscape, the district has distinctive agro-ecological zones for which the main crops produced differ. In the lower altitude maize was the main crop. While potatoes and cabbage were the main crops grown in the upper region, coffee and bananas predominate at the mid-upper and mid-lower altitudes *(Aron, 2019*). Maize in Kapchorwa took long to mature and therefore was grown for only one season per year. The agriculture census of 2008/09 reported that an estimated 49,904 MT of maize was produced from 6,074 hectares in Kapchorwa district (*UBOS, 2010*). Major constraints to maize production in the district included poor soil fertility accruing from poor farming practices, lack of access to input markets due to poor roads, fake seeds, pesticides and fertilizers (*Aron, 2019*).

1.1.3 Maize Production in Tegeres Sub County

Tegeres Sub County was a region in Uganda known for its agricultural productivity. Maize was one of the primary crops grown and here was an overview of maize production in Tegeres Sub County.

Climate and Soil

Tegeres Sub County had a favorable climate for maize production, with an average temperatures ranging from 18^0C to 28^0C and annual rainfall of around 1200mm.The soil was predominantly clay-loam, suitable for maize cultivation

Maize Varieties

Farmers in Tegeres Sub County grow various varieties, including:

Hybrid maize , this refers to a type of maize (corn) that is bred from two different parent lines to produce a new variety with desirable traits. These traits can include:. Higher yields,Improved disease resistance, Increased drought tolerance,Enhanced nutritional contentand Better adaptability to different environments

Hybrid maize is created through a process called hybridization, where two parent lines with specific characteristics are crossed to produce offspring with the desired traits. This process allows farmers to benefit from the strengths of both parent lines, resulting in improved crop performance and productivity.

Longo maize is a hybrid maize variety developed by the Uganda National Agricultural Research Organisation (NARO) and other research institutions.- It was bred to address the needs of smallholder farmers in tegeres and other parts of East Africa.

Longo maize is a result of rigorous research and testing to create a high-yielding, disease-resistant, and drought-tolerant variety. Characteristics are;

Yield: Longo maize is known for its high yields, with average yields ranging from 4-6 tons per hectare.

Maturity, It takes around 120-150 days to mature, making it a medium-maturity variety.

Disease Resistance, Longo maize has good resistance to common maize diseases like maize streak virus, grey leaf spot, and rust.

Drought Tolerance, It is relatively drought-tolerant, making it suitable for areas with unpredictable rainfall patterns. Cultivation Practice's include;

Soil,Longo maize can grow well in various soil types, including clay, loam, and sandy soils.

Climate, It is suitable for tropical and subtropical regions with average temperatures between 20-30°C.

Sowing: Plant seeds 2-3 cm deep and 60-90 cm apart, with rows spaced 90-120 cm apart.

Harvesting, Harvest when the kernels are fully formed and the moisture content is around 20%.

1.2 Problem statement

In Uganda insect pests were the main cause of post-harvest losses during storage *(Dessalegn et al., 2017*). Maize grain loss in Uganda was estimated to be about 20–40% losses during cultivation and 30–90% post-harvest and storage losses (*Odendo et al., 2001).* The maize weevil was the most common storage pest of maize in Kapchorwa, and especially in the Tegeres sub-county as evidenced by research in Uganda's Bako region (*Girma et al., 2008*] As a result, numerous management strategies for post-harvest pests had been put forth, ranging from cultural practices to the application of chemical pesticides. However, there was very little information available in the study areas about farmers' perceptions and awareness of the main maize storage pests, as well as their current management practices. As a result, the current survey would be conducted to assess farmers' perception on the effectiveness of using cultural methods to control maize weevils as to ensure food security in tegeres sub county.

1.2.1 Objectives of the Study

1.2.2. General objective

The main objective of this study was to assess farmers' awareness and perceptions of using cultural methods to control maize weevils in Tegeres sub-county, Kapchorwa district.

1.2.3 Specific objectives

The specific objectives were:

1. To find out the cultural methods employed when controlling maize weevils by farmers in Tegeres Sub-county, Kapchorwa district
2. To determine farmer's perceptions towards different cultural methods used to control maize weevils
3. To assess the challenges faced by farmers in applying cultural methods.
4. To suggest possible solutions to the challenges faced by farmers in applying cultural methods.

1.2.4 Research Questions

In order to effectively answer the above objectives, the following research questions were used:

1. What were some of the cultural methods employed by farmers when controlling maize weevils?
2. What knowledge do farmers have about the different cultural methods used in the control of Maize weevils?
3. What were some of the challenges farmers face when using cultural methods to control maize weevils?

1.2.5 Hypotheses

1. Famers who believed in the effectiveness using cultural methods of controlling maize weevils would have better success in controlling infestations but farmers seem to have negative attitude in using the suggested method.

1.2.6 Justification of the study

Lack of Knowledge and Perception: There was a noticeable gap in farmers' knowledge and perception regarding the effectiveness of plant-based insecticides compared to synthetic ones. This gap was attributed to a lack of contact with agricultural extension workers and a general lac k of awareness about indigenous methods of pest control. This research topic could help address this gap by investigating the effectiveness of cultural methods, such as plant-based insecticides, in controlling maize weevils.

1.2.7 Environmental and Economic Considerations:

The study also pointed out the environmental and economic implications of pesticide use. Many farmers were concerned about the high prices of pesticides, and there was a recognition that these chemicals could have detrimental effects on the environment. This highlighted a need for research into alternative, more sustainable methods of pest control that were also economically viable.

1.2.8 Significance of the study

Maize weevils were a notorious pest that caused substantial damage to stored maize crops. Cultural methods of control involved the use of non-chemical techniques such as crop rotation, proper storage practices, and sanitation. Understanding farmers' perceptions of the effectiveness of these methods was crucial for promoting sustainable and eco-friendly pest management practices in agriculture. Cultural methods offered a more sustainable alternative to chemical pesticides, which could have adverse effects on the environment, human health, and beneficial organisms. By exploring farmers' perceptions, the research could contribute to promoting and encouraging the adoption of cultural pest control methods, ultimately leading to more sustainable agricultural practices.

Economic Impact: Maize was a staple crop in many regions, and weevil infestation could lead to significant economic losses for farmers. Having understood farmers' perceptions of cultural methods, the research could provide insights into the economic viability of these techniques and helped identify potential barriers or challenges faced by farmers in adopting them.

Farmer Empowerment: Farmers' opinions and experiences were often overlooked in research and policy decisions. By focusing on farmers' perceptions, the research acknowledged their expertise and provided a platform for their voices to be heard. This approach empowered farmers by involving them in decision-making processes and promoted farmer-led innovation in pest management practices. Despite the importance of cultural methods in pest control, there might be limited research on farmers' perceptions specifically related to maize weevils. This research topic helped fill this knowledge gap and provided valuable insights into the effectiveness and potential challenges associated with using cultural methods to control maize weevils.

1.2.9 The scope of the study

This research was conducted in Tegeres sub county, Kapchorwa district in eastern Uganda. It considered the cultural methods of controlling maize weevils, the farmer's perception, the challenges faced by farmers when using cultural methods of controlling maize weevils and the possible solutions to these challenges.

The research was conducted for five months.

1.2.10 Conceptual framework

Farmers' knowledge and awareness of cultural control methods, as well as the availability and accessibility of these resources, directly influenced their perception of the effectiveness of these methods.

Farmers' experience and adoption of cultural control methods shaped their perception of effectiveness, as they had better understanding of the practical challenges and benefits of these methods.

Environmental factors, labor and time requirements, and access to extension services and information acted as moderating variables, influencing the relationship between the independent variables (knowledge, availability, and experience) and the dependent variable (perception of effectiveness).

CHAPTER TWO

LITERATURE REVIEW

2.1 Introduction

The review of literature was carried out in accordance with the study objectives as follows: To find out the cultural methods employed when controlling maize weevils by farmers in Tegeres Sub-county, Kapchorwa district, to determine farmer's perceptions towards different cultural methods used to control maize weevils, to assess the challenges faced by farmers in applying cultural methods. and to suggest possible solutions to the challenges faced by farmers in applying cultural methods.

2.1.0 Farmers perceptions on control of maize weevil

Perceptions referred to the way individuals received, organized and interpreted the particular event in their environment (*Saeed, 2023*). When an individual received information about something new for example a new technology, it formed the basis of the perceptions and attitudes this individual had towards it. In the case for farmers, their perceptions about innovations were determined by the knowledge they had and past experiences. In agriculture, individual perceptions used to explain the behavior towards the adoption of new technologies. Maize weevils were a common pest that caused significant damage to maize crops. Farmers often had mixed perceptions about cultural methods for controlling maize weevils (*Nwosu L. C., 2018*). Some farmers believed that cultural methods, such as properly drying and storing maize produce, effectively controlled maize weevils. They believed that these methods reduced the moisture content of the maize, making it less favorable for weevil infestation. These farmers believed that adopting cultural practices like sun drying, smoking, or air drying not only protected their maize crops from weevil infestation but also improved the market price of their produce. However, other farmers had a different perception and believed that cultural methods alone were not sufficient for effective

control of maize weevils (*Hurley, 2020*). They believed that cultural methods should be used in combination with other pest control measures, such as insecticides or biological agents, for better results. They believed that relying solely on cultural practices did not provide adequate protection against maize weevils

Farmers understood that crop rotation was an effective cultural method for controlling maize weevils. By alternating the cultivation of maize with other crops, farmers disrupted the life cycle of the weevils and reduced their population (*Vasileiadwas, 2011*). Additionally, proper storage of maize grains was crucial in preventing infestations. Farmers ensured that the moisture content of stored maize was below 13% and stored it at low temperatures to discourage weevil growth. Some farmers utilized good sanitation practices, such as thorough cleaning of storage areas and removing any leftover crop residues, minimized the chance of infestation. Employing these cultural methods, farmers aimed to reduce their reliance on chemical pesticides and promoted sustainable pest management practices. Farmers had found that cultural methods such as crop rotation, proper storage techniques, and sanitation practices were effective in controlling maize weevils. By integrating these cultural practices into their farming routines, farmers had observed a decrease in maize weevil infestations and improved crop yields. Farmers had found that cultural methods such as crop rotation, proper storage techniques, and sanitation practices were effective in controlling maize weevils. These methods not only reduced the reliance on chemical pesticides but also promoted sustainable farming practices. Farmers understood the importance of using cultural methods for controlling maize weevils. They recognized that these methods not only helped reduce the population of weevils but also contributed to overall crop health and sustainability. Some farmers utilized biological control measures such as releasing natural enemies of maize weevils, parasitic wasps or predatory beetles (*Jaidka, 2020*)

2.1.1 Cultural Methods of Controlling Maize Weevils

Cultural methods referred to non-chemical control methods such as crop rotation, intercropping, and storage practices. Infestation of maize beetle was reduced by good store hygiene, such as cleaning the store between harvests, removing and burning of infested residues, fumigating the store house to eliminate residual infestation and selecting only uninfected grains for storage. Harvesting the maize immediately after maturity reduced the chances of attack by maize beetle. The use of resistant seed varieties also reduced the severity of infestation.

2.1.2 Methods of maize storage (Temporary Storage Methods of maize)

(i) Aerial Storage

Maize cobs, sorghum or millet panicles were sometimes tied in bundles, which were suspended from tree branches, ropes, or inside the house. This method of storage was not suitable for very small or very l2 rage quantities of maize and did not provide protection against the weather (if outside), insects, rodents, or thieves, was a serious problem to this storage system or type.

(ii) Ground storage,

This method of storage was temporal, since the grains were exposed to all pests, including domestic animals, and the weather. This method was utilized only if the producer was compelled to attend to some other task, or lacked means of conveying the grains to the homestead.

(iii) Open Timber Platforms

A platform which consisted mainly of a number of relatively straight poles laid horizontally on a series of upright posts. Grains were stored on platforms in heaps, woven baskets or in bags. In humid countries, fire might be lit under elevated platforms; these dried the produce and detered insects or other pests from infesting them.

Long-term maize storage methods

(i) Storage baskets (cribs)

In humid countries, where grains could not be dried adequately prior to storage and needed to be kept well-ventilated during the storage period, traditional granaries (cribs) were usually constructed. Under prevailing climatic conditions, most plant materials rotted fairly quickly and most cribs were replaced every two or three years although bamboo structures may last up to 15 years, with careful maintenance.

(ii) Calabashes, gourds, earthenware pots

These small capacity storage containers were mostly used for storing seeds and pulse grains, such as cowpeas. They had small openings; they were made airtight by
sealing the walls inside and out with liquid clay and closing the mouth with stiff clay or a wooden cork. If the grain dried (less than 12% moisture content); then there was usually no problem with this kind of storage, as they would store properly without fear of spoilage.

(iii) Jars

These were large clay storage containers; whose shape and capacity varies from place to place. The upper part was narrow and closed with a flat stone or a clay lid: which was sealed in position with clay or other suitable materials. Generally, they were mainly kept in dwellings they served equally for storing seeds and legumes so they could remain in good condition, and not be exposed to the sun.(*Neacşu & Madar, 2010)*

(iv) Solid wall bins

Such grain stores, were usually associated with dry climatic conditions, in it, it was possible to reduce the moisture content of the harvested grains to a satisfactory level simply by drying them

under the sun. The base of a solid wall bin were made of timber, earth or stone. Earth was not recommended because it permitted termites and rodents to enter, better base was made of stone. Mud or clay silos were either round or cylindrical in shape, depending on the materials used for its construction. Rectangular-shaped bins of this type were less common, because the uneven pressure of the grain inside caused cracking - especially at the corners. Clay, which was the basic material, varied in composition from one place to another. The type most commonly used for such construction work was obtained from termitaries, because the termites add a secretion which gave it better plasticity. The roof was usually made of thatched grass, with a generous overhang to protect the mud wall (s) from erosion. Where a side door or a detachable 'cap' was not provided, the roof had to be lifted for access to the bin. Such silos can serve for 30 to 50 years.

(v) Underground Storage

This storage system was practiced in countries like India, Turkey, sahelian countries and southern Africa. This method of storage was used in dry regions where the water table did not endanger the contents. Conceived for long term storage, pits vary in capacity (from a few hundred kilograms to 200 tons)

2.2.3 Challenges Faced by Farmers to Control Maize Weevils

One of the primary challenges was the limited availability and accessibility of effective control methods. While chemical pesticides had been widely used to control maize weevils, their use was often associated with health and environmental concerns, as well as the development of insecticide resistance (*Thomas W. Phillips, 2018*). Alternative control methods, such as the use of botanical pesticides or biological control agents, had shown primase, but their adoption by farmers has been limited due to factors such as cost, availability, and lack of awareness (*Baoua et al., 2014*).

Lack of knowledge and technical skills among farmers regarding the proper implementation of control measures. Many farmers relied on traditional storage practices, such as storing maize in sacks or on-farm structures, which did not provide adequate protection against weevil infestations (*Pragya Kandel, 2021*). Educating farmers on the benefits and proper usage of improved storage techniques, such as the use of hermetic storage bags or silos, was a significant challenge, especially in remote or resource-constrained areas (*Thomas W. Phillips, 2018*).

The effectiveness of control measures can be influenced by environmental factors, such as temperature and humidity, which varied significantly across different regions and seasons (*Baoua et al., 2014*). Farmers faced challenges in adapting their control strategies to these changing conditions, which impacted the success of their weevil management efforts.

The implementation of control measures was labor-intensive and time-consuming for farmers, particularly during the busy harvest season (*Pragya Kandel, 2021*). Farmers prioritized other agricultural activities, leading to the neglect of important preventive measures against weevil infestation

The lack of access to reliable information and extension services was a significant challenge for farmers. Many farmers did not have the necessary knowledge or resources to effectively identify and manage maize weevil infestations,

2.2.4 Possible Solutions to Challenges Faced by Farmers Using Cultural Methods to Control Maize Weevils

One potential solution to the limited availability and accessibility of resistant maize varieties was the development and promotion of improved, weevil-resistant cultivars. Researchers had made progress in breeding maize varieties with enhanced resistance to weevil infestations, but the adoption of these varieties by farmers had been slow (*Pragya Kandel, 2021*) Increased investment

in breeding programs, coupled with effective seed distribution systems and subsidies, could help to improve the availability and affordability of resistant maize varieties for smallholder farmers (*Baoua et al., 2014*).

To address the lack of knowledge and awareness among farmers regarding proper post-harvest storage practices, targeted extension and training programs were implemented. These programs could focus on educating farmers on the benefits of improved storage techniques, such as the use of hermetic storage bags or silos, and providing hands-on training on their proper use and maintenance (*Nukenine et al., 2010*). Collaboration between research institutions, extension services, and farmer organizations were crucial in the effective dissemination of this knowledge (*Tefera et al., 2011*).

The challenge of the labor-intensive nature of sanitation practices was addressed through the development and promotion of labor-saving technologies. For example, the use of automated or semi-automated cleaning and disinfection systems for storage facilities helped to reduce the time and effort required by farmers (*Baoua et al., 2014*). Additionally, the integration of these technologies with other cultural control methods, such as the use of resistant varieties, further enhanced the effectiveness of the overall weevil management strategy.

To address the influence of environmental factors on the effectiveness of cultural control methods, researchers focused on developing context-specific recommendations and decision-support tools. This involved the use of predictive models or decision-support systems that helped farmers adapt their control strategies to the prevailing environmental conditions (*Nukenine et al., 2010*). Collaboration between researchers, extension services, and farmers were crucial in the development and dissemination of these context-specific solution

To improve the access to reliable information and extension services, the establishment of farmer-centric information hubs or networks were a valuable solution. These hubs could provide farmers with access to up-to-date information on weevil management, as well as facilitate the exchange of knowledge and best practices among farmers (*Tefera et al., 2011*). The use of digital technologies, such as mobile applications or online platforms, further enhanced the reach and accessibility of these information resources.

CHAPTER THREE

RESEARCH METHODOLOGY

3.1 Introduction

This chapter describes the various tools the researcher used in getting information related to topic under investigation

3.1.1 Research design

Research design referred to a framework of methods and techniques chosen by a researcher to combine various components of research in a reasonably logical manner so that the research problem was efficiently handled. This study adopted a cross sectional survey research, (*Kothari, 2005*) described descriptive research included survey and facts found enquiries adding that the major purpose of descriptive research was description of affairs as it exists at present. A descriptive research determines and report the way things were attempted and described such things as possible behavior, attitudes, values and characteristics, (*Mugenda, 2003*).

Descriptive research design, in a descriptive research design, a researcher was solely interested in describing the situation or case under his/ her research study. It was a theory based research design which was created by gather, analyzed and presented collected data The method of data collection was tested for validity and reliability, conditions which according to (*Kothari, 2005)* must be present in descriptive studies.

3.1.2 Target Population

The target population of the study would be farmers who were actively participating in the use of cultural methods to control maize weevils in Tegeres sub-county Kapchorwa District, Eastern Uganda.

3.1.3 Sampling technique

Sampling procedure was defined as a systematic process of identifying individuals for a study to represent the larger group from which they were selected (*Mugenda, 2003*). A sample was a small group obtained from accessible population *(Mugenda, 2003).*

Tegeres sub-county kapchorwa District was selected for the study because there were many farmers who actively participated in using cultural methods to control maize weevils. The farmers that used would be randomly selected to give each farmer an equal opportunity to participate in the study. A list of farmers obtained from the production officials from the sub county would act as a sampling frame. The study used random sampling technique. This was chosen because equal opportunity would be accorded to each respondent to give their opinion on the matter.

3.1.4 Data Instruments

Basing on the nature of the research topic, the researcher was able to use an interview guide as a tool which can enable her to adequately collect data from the field. The interview guide was developed and many copies made which was then supplied to a number of respondents to respond to the various research questions under investigation. The tool i.e. the interview guide is properly displayed under appendix 1.

3.1.5 Validation of Research Instrument

Validity referred to how well an instrument measured what it was intended to measure. Validity which was internal validity and external validity. Validity referred to how the research findings match reality while external validity referred to the extent to which the research findings replicated to other environments (Pelwisier, 2008). Validation of the research instrument was done by use of pilot study. Prior to the actual study, pilot test of the measures was conducted against prospective sample population in order to measure validity. The subject to be approached during piloting was marked so that they could not be applied at the final study. The wording of the item was carefully modified based on the pilot test outcomes and reviews. Pre- testing the questionnaire was of great significance in this survey. The questions would be reexamined to ensure that they were not ambiguous, confusing or potentially offensive to the respondents leading to biased responses. This enhanced the validity of the research instrument.

A sample size of 15 was chosen to form the pilot study, in order to measure the validity and reliability of data collection instruments. A pilot study was small scale preliminary study conducted in order to evaluate feasibility, duration, cost, adverse events and improve upon the study design prior to performance of a full scale research project Bills (2010).

3.1.6 Reliability Test

A pilot study carried out whereby the interview guide would pretest respondents outside the sample population. The researcher administered the instruments personally to all respondents. The feedback was used to validate the instruments in readiness for the study. After administering the

instruments to the selected respondents, the data obtained was used as a true reflection of the variables under study. To test the reliability of the instruments, the researcher split into two sub sets (the sets which have odd numbers and even numbers). All even numbered items and odd numbered responses in the pilot study was computed separately. The main aim determined the co-efficient of internal consistency and the reliability coefficient whole value varied between 0.00 (indicating no reliability). The odd numbered scores for all items were correlated with even numbered scores using Pearson Product Moment Correlation coefficient of the entire test, where the coefficient was assumed to be 0.06 which was perfect reliability. The researcher used Spearman Brown Prophecy formula.

3.1.7 Data Collection Procedures

Interview guide were to be designed as per the objectives of the study. The study will use primary data; this was to be collected through self-administration interview guide. Structured interview guide was used to collect data on respondent's perception on the effectiveness of using cultural methods to control maize weevils in Tegeres sub-county Kapchorwa District.

The research adopted interview guide as the instrument for data collection. The interview guide had both closed and open ended questions on the Perception of using cultural methods to control maize weevils. This interview guide was structured to elicit specific responses for qualitative analysis. The interview guide was read to the respondents.

3.1.8 Data Analysis

To assess the farmers' perception on the effectiveness of using cultural methods to control maize weevils in Tegeres sub county Kapchorwa district, Uganda. Cross- sectional analysis was carried out to generate frequency, percentile, mean, median, mode, standard deviation and cumulative frequency. Analysis of social economic factors affecting farmers in Tegeres sub-county kapchorwa district collected and entered into Software Package for Social Scientist (SPSS), cleaned, coded and classified to remove irregularities. Independent t- test and chi square was used to test for differences in means and proportions respectively. Qualitative data was used to complement and interpret the gender gaps for participation in community agricultural programs. Data was analyzed in order to inspect, clean, transform and model data in order to get useful information, suggesting solutions, conclusion and making decision making.

3.1.9 Ethical Issues

There were ethical issues related to the study and they addressed by maintaining high level confidentiality of the information volunteered by the respondents and never intending to use the information for other purposes other than drawing the conclusion of the study. The name of the respondents was optional and not to be disclosed to protect their rights. All the personal details were limited to general information.

CHAPTER FOUR

DATA PRESENTATION, ANALYSIS AND INTERPRETATION

This chapter contains presentation and interpretation of findings for all the study objectives,

Evidently shown as reflected in chapter one of this report. This chapter clearly looked at data collected by the researcher from the field, interpretation and analysis. The sample size of 50 respondents was used.

4.1 Socio-demographic data of respondents

This section of the study discussed the characteristics of the respondents at selected villages in Kapchorwa Municipality especially gender trait that was captured where we have different number of male and female farmers. The researcher adopted frequency tabulations to present and discuss the results of the sample characteristics below. The rationale of using frequency tabulation was to determine the categories of the different characteristics in relation to the responses of the respondents.

4.1.1 Respondent Category by Gender

Frequency tabulation was used by the researcher to present the respondent category and gender distribution categories of the respondents. Table 4.1 below presents the results:

Table 1: Gender of respondents

		Frequency	Percent	Cumulative Percent
Valid	Male	70	70	70
	Female	30	30	100

	Total	**100**	**100**	

Source: Primary data, 2024

The results from Table 4 above show that 70% of the respondents were male whereas 30% were female. The findings revealed that males were more responsive compared to their female counterparts, indicating that there were more male respondents in the selected villages compared to the female respondents which relates to the fact that more males are farmers compared to females. The high composition of male respondents is a justification that more males have done farming due to the local traditional culture where males are considered more superior compared to the female counterparts.

4.1.2 Respondent Category by age bracket

Table 2:Age bracket of the respondents

		Frequency	**Percent**	**Cumulative Percent**
Valid	**20-30 years**	20	20	20
	31-39 years	50	50	70
	40-49 years	25	25	95
	50-59 years	5	5	100
	Total	**100**	**100**	

Source: Primary data, 2024

The above table shows that out of the 100 respondents selected for the study, 20% of the respondents are in the age brackets of 20-30 years, 50% of the respondents are in the age bracket of 31-39 years, 25% of the respondents are in the age brackets of 40-49 years while the least 5% of the population is in the age bracket of 50-59 years. This therefore means that there were many young people who participated in conducting the research compared to the number of the old group of people who also participated in carrying out the research.

Table 3:Effects of maize weevils in Tegeres sub county, Kapchorwa Municipality.

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Highly destructive	50	50	50	50
	Destructive	25	25	25	75
	Neutral	13	13	13	88
	Not destructive	12	12	12	100
	Total	**100**	**100**	**100**	

Source: Primary data, 2024

The above table shows that out of the 100 respondents selected for the study, 50% of the respondents say maize weevils are highly destructive to farmer's crops, 25% say maize weevils are destructive, 13% are not very sure if maize farmers are destructive or not while 12% of the farmers say that maize weevils are not destructive to farmers crops i.e. maize. Basing on this information, most of the farmers agree that maize weevils are a bigger problem to the farmer's maize which comprises of those who say its destructive and those who say highly destructive which comprise of 75% which is a very large percentage of 75%.

4.1.3 Respondent Category by number of farmers who use cultural methods of maize weevil control

Frequency tabulation was used to present the distribution of the respondents by number of farmers who use cultural methods of maize weevil control

. Table 6 below presented the results:

Table 4:Effectiveness of using cultural methods in controlling maize weevils

		Frequency	Percent	Valid Percent	Cumulative percent
	Very effective	40	40	40	40
	Effective	50	50	50	90

Valid	Neutral	0	0	0	90
	Not effective	10	10	10	100
	Total	**100**	**100**	**100**	

Source: Primary data, 2024

The results from Table 4.3 show that 0% of the respondents are not sure about the effectiveness of using cultural methods in controlling maize weevils. 40% of the respondents acknowledge that cultural methods was very effective, 50% acknowledge that cultural methods are effective while 10% of the respondents testify that cultural methods are not effective in controlling maize weevils in a maize plantation.

Basing on the above information, 90% of the respondents acknowledge that cultural methods in effective in controlling maize weevils which is out of the 40% who say its highly effective and the 50% who say its effective meaning cultural methods can be a good measure in controlling maize weevils in the country.

4.1.4 Challenges faced by farmers when using cultural methods of controlling maize weevils

Table 5:Number of respondents who facing challenges in using cultural methods of maize weevil control

		Frequency		**Percent**	**Valid Percent**	**Cumulative percent**
Valid	Very difficult	40		40	40	40
	Difficult	30		30	30	70
	Neutral	0		0	0	70
	Easy	20		20	20	90
	Very easy	10		10	10	100
	Total	**350**		**100**	**100**	

Source: primary data 2024

From Table 7, majority of the respondents 40% testifies that it's very difficult for farmers to use cultural methods of controlling maize weevils, 30% testifies that it's difficult for farmers to use cultural methods while controlling maize weevils, no farmer is sure on whether it's challenging using cultural methods or not, 20% testify that it's easy for them to use cultural methods of controlling maize weevils while 10% of the respondents perceive that it's very easy for them(farmers) to use cultural methods of controlling maize weevils in their stores.

In conclusion therefore, the majority of the respondents testify that its indeed challenging for the farmers which is 70% to perceive that using cultural methods of maize weevil control if challenging to them that is why most of them prefer using chemical means as opposed to using cultural means.

4.1.5 Solutions to the challenges faced by farmers while using cultural methods of controlling maize weevils

Table 6:Respondents perceptions on the number of solutions to challenges in using cultural methods of maize weevil control

		Frequency	Percent	Valid Percent	Cumulative percent
Valid	Many solutions	70	70	70	70
	Limited solutions	30	30	30	100
	No solutions	0	0	0	
	Total	**100**	**100**	**100**	

Source: Primary data, 2024

The study requested the respondent to indicate their views about the number of solutions to the challenges faced while using cultural methods in controlling maize weevils. From the findings it was established that 70% of the respondents agreed that there are many solutions that can be used in controlling maize weevils within the locality.30% testified that there are limited solutions to the challenges farmers face while using cultural methods in controlling maize weevils while no

respondent testified that there are no solutions to the challenges farmers face in using cultural methods of controlling maize weevils.

In conclusion therefore, the largest percentage 70% who say there are numerous solutions to controlling maize weevils confirms that even if it's challenging to use cultural methods, it means there are various solutions to the challenges respondents face in using cultural methods meaning the method is very good in controlling maize weevils.

CHAPTER FIVE

SUMMARY OF FINDINGS, CONCLUSIONS AND RECOMMENDATIONS

This chapter contains the summary of findings of the current study, conclusions and recommendations. This chapter clearly looked at the data analyzed and interpreted by the researcher from the field. The sample size of 100 respondents participated in the study.

5.1 Summary of the findings

5.1.1 Socio-demographic data of respondents

According to the study findings, 70% of the respondents were male, while 30% of the respondents were female. Also there was a greater percentage of over 70% of the entire population or respondents who participated in the research compared to a smaller percentage of less than 30% of the senior men and women who participated in the research.it therefore means that few old people are currently involved in farming compared to the young generation and that is why many views were being collected from the young people.

5.1.2 Cultural methods of controlling maize weevils

From the information in the above chapter, it shows that cultural method is a good method of controlling maize weevils. 90% of the farmers who respondent perceive that using cultural methods in controlling maize weevils is an effective method and they say its 90% effective in controlling maize weevils. This means that the method works and it should be bought by most farmers now in controlling maize weevils in the community. This method should therefore be used by anybody in the world because it's an effective mechanism in controlling maize weevils within the society

5.1.3 Effects of maize weevils to maize in Tegeres Sub County, Kapchorwa Municipality

Basing on the findings in chapter four, it shows that over 70% of the respondents testify that maize weevils is indeed a great disaster in the sub county while a very small percentage of less than 5% testify the maize weevils do not have effects to farmer's maize in the sub county. From this background, it therefore means that maize weevils are pests which should greatly be looked at because their implications alone negatively affect the farmers in a great negative manner which results in greater loss and poverty in the region.

5.1.4 Challenges faced by farmers while using cultural methods of controlling maize weevils.

The study also examined that over 70% of the respondents or farmers testify that its indeed challenging for farmers to use cultural methods while controlling maize weevils. They outlined challenges including the process of transporting the various things which could be used in the process of controlling these pests. most of them said the entire process is very manual and very mechanical which needs a lot of labor, energy and even resources inform of money to support the entire process. They also said for the pests to be effectively dealt with, the entire process is very slow thus a great challenge.

5.1.5 Solutions to the challenges when using cultural methods in controlling maize weevils

Findings from the respondents over 80% of the respondents confirmed that much as using cultural methods is challenging, the challenges as well have many solutions and should therefore not supposed to a problem to the farmers in using the above method in controlling maize weevils.it therefore means that cultural methods in controlling maize weevils should not only be used within Tegeres sub county, Kapchorwa Municipality but should be adopted in the entire part of the country and even expand beyond the borders of Uganda.

5.2 Recommendations

There is need for the local community and even beyond to embrace the issue of using cultural methods in controlling maize weevils than using any other method of controlling maize weevils.

There is need for the extension workers in the sub county and the whole district to adequately sensitize the farmers in the region about the various pests, ways of controlling these pests and first of all embrace the use of cultural methods in controlling these pests.

Farmers should also be sensitized on the effects of the various farm pests and on mechanisms these pests can be controlled in our farms. Most of these pests are very destructive to farmers' crops and should not be given any space so as to minimize the issue of making losses on the farmer's side.

Appendix 1

Farmers' Perceptions towards Cultural Methods for Control of Maize Weevils *(Sitophilus Zeamays)* in Tegeres Sub County, Kapchorwa District

Interview Guide for Farmers

Introduction

I am conducting a study on *farmers' perception on the effectiveness of using cultural methods to control maize weevils in Tegeres Sub County*. The findings will be used to improve farmers' methods for control of maize weevils. You were identified as a suitable respondent to the study because of your experience on maize production in this area. Please kindly answer my questions as honestly as possible. Your information will be treated confidentially for research purposes only. Your time and effort in answering these questions are highly appreciated.

SECTION A: BACKGROUND INFORMATION.

Respondents' identification village……

Gender……..

Age bracket ☐ *20-30 years*

☐ *31-39 years*

☐ *40-49 years*

☐ *50-59 years*

SECTION B: EFFECTS OF MAIZE WEEVILS

Talk to me about the effects of maize weevils. Thereafter probing starts(questions will be asked depending on the initial answers but will be in linewith research questions)

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SECTION C: CULTURAL METHODS OF CONTROLLING MAIZE WEEVILS

Talk to me about your perception on using cultural methods of controlling maize weevils. Thereafter probing starts(questions will be asked depending on the initial answers but will be in linewith research questions.)

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SECTION D: CHALLENGES FACED IN USING CULTURAL METHODS OF CONTROLLING MAIZE WEEVILS

Talk to me about the challenges faced while using cultural methods of controlling maize weevils. Thereafter probing starts(questions will be asked depending on the initial answers but will be in line with research questions.)

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SECTION E: SOLUTIONS TO THE CHALLENGES FACED WHILIE USING CULTURAL METHODS OF CONTROLLING MAIZE WEEVILS

Talk to me about the solutions to challenges faced while using cultural methods of controlling maize weevils. Thereafter probing starts(questions will be asked depending on the initial answers but will be in linewith research questions.)

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……

Talk to me about the effects of maize weevils in your locality. Thereafter probing starts(questions will be asked depending on the initial answers but will be in linewith research questions)

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Thank you for your participation

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