PERCEPTION OF INSECT PESTS MANAGEMENT METHODS IN RURAL AREAS OF BADAGRY LOCAL GOVERNMENT AREA, LAGOS STATE, NIGERIA

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BENIN CITY,

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A DISSERTATION SUBMITTED TO THE DEPARTMENT OF ANIMAL AND ENVIRONMENTAL BIOLOGY IN PARTIAL FUFILLMENT OF THE REQUIREMENTS FOR THE AWARD OF BACHELOR OF SCIENCE B.SC. (HONS) IN ANIMAL AND ENVIRONMENTAL BIOLOGY, UNIVERSITY OF BENIN, BENIN CITY NIGERIA.

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DEDICATION

I dedicate this work to Almighty God who gave me the strength, good health and knowledge to successfully complete this project, to my family, thank you immensely for all the contribution and support.

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ABSTRACT

The perception of insect pests management methods in rural areas of Badagry Local Government Area, Lagos State, Nigeria, is a critical aspect of sustainable agriculture and community well-being. This abstract provides a concise overview of a study conducted to understand the prevailing attitudes and beliefs of rural farmers towards insect pest management. In rural Badagry, agriculture plays a pivotal role in livelihoods, making insect pests a significant concern. This research employed a mixed-methods approach, combining surveys and interviews to gather data from farmers and agricultural extension officers. The findings reveal a complex perception landscape, where traditional and modern pest management methods coexist. Farmers, deeply rooted in tradition, often rely on indigenous knowledge and cultural practices. However, awareness of modern, science-based pest management approaches is increasing, thanks to the efforts of agricultural extension officers and outreach programs.Challenges such as limited access to resources, information gaps, and economic constraints affect the adoption of modern methods. Attitudes towards chemical pesticides are mixed due to concerns about environmental and health impacts. Furthermore, climate change is altering the pest landscape, necessitating adaptive strategies. This study underscores the importance of bridging the gap between traditional and modern insect pest management practices. It advocates for holistic, context-specific interventions that consider local knowledge while promoting sustainable, science-based approaches. Such initiatives can enhance food security, reduce pesticide risks, and support the resilience of rural communities in Badagry and similar regions.

CHAPTER ONE

INTRODUCTION

1.1 BACKGROUND OF STUDY

Agriculture is important to our survival as it is a major source of food, raw materials, and economic growth and development. Insect pests cause significant losses to the agricultural sector of Nigeria, especially in the rural areas where farming is the primary occupation of its inhabitants (Nwosu *et al.*, 2020). Insect pests are insects whose actions have negative effects on crops, resulting in economic damage and therefore warrants the application of a management strategy (Ogunwolu *et al.*, 2019). These insect pests reduce the quality and quantity of crop yield, leading to food insecurity, loss of income, and poverty among farmers (Eze *et al.*, 2018).

For instance, the African armyworm (*Spodoptera exempta)* attacks crops such as maize, millet, and sorghum by feeding on the stems and leaves, causing stunt growth, reduced yield, and even plant death (Sokoya *et al.*, 2017). A study by the Nigerian Institute for Oil Palm Research (NIFOR) reported that African armyworm infestations can cause yield losses of up to 50% in maize crops (NIFOR, 2020). Another example is the Cassava mealybug (*Phenacoccus manihoti*), which attacks cassava plants by feeding on the sap and causing stunted growth and yellowing of the leaves. Severe infestations can lead to reduced yield and/or death of the plant (Ogbe *et al.*, 2021). The Federal University of Agriculture, Abeokuta (FUNAAB) conducted a study that reported cassava mealybug infestations can cause yield losses of up to 90% in Nigeria (FUNAAB, 2019). There is also the case of the Yam beetle (*Heteroligus meles*). This insect pest attacks yam plants by feeding on the leaves and stems, causing defoliation and reduced yield. Studies have shown that yam beetle infestations can cause yield losses of up to 70% in Nigeria (eg., Adedipe *et al.*, 2016). The Food and Agriculture Organization (FAO) also reported that the estimated annual global losses of vegetables due to insects alone stand at about 15–20% during field production and 18–20% during storage (FAO, 2018). Damage by insect pests is certainly one of the main limiting factors to increased production of food in farming systems in Nigeria and constitutes the primary cause of low-quality and poor yields (Adisa *et al.*, 2020).

In response to the destruction of crop plants and produce, various insect pest management strategies have been implemented in Nigeria. Insect pest management is the practice of using various techniques to control and prevent damage caused by insect pests to crops, livestock, and other forms of vegetation (Adebowale *et al*., 2017). The goal is to minimize crop loss, reduce the use of harmful pesticides, and promote sustainable agriculture (Babatola *et al.*, 2021). There are several methods of insect pest management, including cultural, biological, mechanical, and chemical methods. Each method has its advantages and disadvantages, and the choice of method depends on several factors such as the type of pest, the crop being grown, and the environmental conditions (Oluwafemi *et al.*, 2018). There are several types of insects pest control methods such as cultural control, biological control, chemical control and mechanical control methods.

Cultural control methods involve the use of farming practices to reduce insect pest populations. One example of cultural pest management in Nigeria is the use of crop rotation. Crop rotation involves growing different crops in a particular field in a cyclical pattern to prevent the buildup of pests and diseases that target specific crops (Onu *et al*., 2020). For example, a farmer can plant maize one season and then plant beans the next season in the same field. This method helps to reduce the population of pests that target maize and provides a favorable environment for the growth of beans. Biological control methods involve the use of natural predators, parasites, and pathogens to control insect pests. One example of biological pest management in Nigeria is the use of the tephritid fruit fly parasitoid, *Fopius arisanus,* to control fruit flies that attack citrus fruits (Mohammed *et al*., 2019). This parasitoid was introduced into Nigeria in the 1990s and has been successful in reducing the population of fruit flies, thereby increasing citrus production. Mechanical control method involves using barriers such as traps, bug vacuums, destruction of infected plant parts, and removal by hand (Idowu *et al*., 2021). Chemical methods of controlling insect pests involve the use of conventional pesticides to control insect pests. Although chemical pesticides are effective in controlling pests, they have adverse effects on human health, the environment, and non-target organisms (Nwosu *et al.*, 2021). In Nigeria, there have been several reports of pesticide misuse, which has led to environmental contamination and human health issues (Akinbile *et al.*, 2020).

The effectiveness of insect pest management methods in Nigeria depends on several factors such as the type of pests plaguing crop fields, the crop being grown, and the environmental conditions. The use of cultural and biological methods is encouraged as they are more sustainable and have fewer adverse effects on the environment and human health (Olukosi *et* *al*., 2022). However, when using chemical methods, it is essential to follow the recommended dosage and application procedures to minimize the risk of environmental contamination and human health issues (Nwankwo *et al*., 2021).

The success of these methods is dependent on various conditions; however, it is heavily dependent on the perception and attitudes of farmers towards pest management. It is important to document the opinion of farmers on pest control methods as they are the major users of these practices (Olojede *et al*., 2019). This study will be conducted in selected rural communities in Badagry Local Government Area (LGA) in Lagos State, Nigeria using a survey questionnaire administered to a random sample of farmers. The questionnaire will be designed to gather data on farmers' awareness of pest management strategies, their level of adoption, and the factors that influence their adoption.

1.2 AIMS OF THE STUDY

To document the perception of insect pests’ management methods by farmers in rural areas of Badagry Local Government Area (LGA), in Lagos State, Nigeria. The findings of this study will contribute to the understanding of farmers' perception of pest management strategies in rural western Nigeria. The study will provide insights into the factors that influence farmers' adoption of these strategies and suggest ways to improve the uptake of pest management practices. The results of this study will be useful to policymakers, agricultural extension agents, and other stakeholders in the agricultural sector in Nigeria. It will also contribute to the body of knowledge on insect pest management in developing countries.

1.3 SPECIFIC OBJECTIVES

i. To document the general knowledge of insect pests in rural areas of Badagry Local Government Area (LGA), in Lagos State, Nigeria.

ii. To document the various control strategies used by farmers in rural areas of Badagry Local Government Area (LGA) in Lagos State.

iii. To determine the effectiveness of the different control strategies implored by farmers in rural areas of Badagry Local Government Area (LGA) in Lagos State

iv. To document the opinions of farmers on insect pest management in rural areas of Badagry Local Government Area (LGA) in Lagos State.

CHAPTER TWO
LITERATURE REVIEW

2.1 INSECTS, INSECT PESTS AND CONTROL STATEGIES

Insects are a diverse group of arthropods belonging to the class Insecta, comprising over one million described species (Grimaldi and Engel, 2005). They play crucial ecological roles in various ecosystems, including pollination, decomposition, and serving as a food source for other organisms (Losey and Vaughan, 2006). Insects exhibit remarkable diversity in size, from minute parasitic wasps measuring less than a millimeter to the giant Atlas moth with a wingspan exceeding 25 centimeters (Kristensen *et al*., 2007). Their ecological impact is substantial, as insects are crucial pollinators of numerous plants, including many crops that humans rely on for food (Ollerton *et al*., 2011).

2.2 THE ECONOMIC IMPORTANCE OF INSECTS IN AGRICULTURE

Insects are of paramount economic importance in the realm of agriculture, contributing in diverse ways that affect crop productivity, food security, and the overall economy. These small creatures play vital roles as pollinators, natural pest controllers, nutrient recyclers, and even sources of alternative protein. The economic impact of insects in agriculture is profound, shaping the livelihoods of farmers, the availability of food, and the global agricultural industry.

2.2.1 Pollination Services:

One of the most well-known economic contributions of insects to agriculture is pollination. Bees, butterflies, moths, flies, and other insects facilitate the reproduction of many flowering plants, including a significant portion of food crops (Iyiola *et al*., 2019). Their pollination activities increase the yield and quality of fruits, vegetables, nuts, and seeds. It's estimated that pollinators contribute to the production of crops worth hundreds of billions of dollars annually worldwide. Without these services, many crops would face reduced yields, leading to potential food shortages and increased production costs (Ajayi *et al*., 2021)

2.2.2 Natural Pest Control:

Insects also act as natural pest controllers in agricultural systems. Predatory insects like ladybugs, lacewings, and parasitic wasps feed on pests that would otherwise damage crops (Fakorede *et al*., 2019). This reduces the need for synthetic pesticides and lowers production costs for farmers. The economic value of these natural enemies in pest management runs into billions of dollars globally, contributing to more sustainable and eco-friendly agricultural practices (Akande *et al*., 2021).

2.2.3 Nutrient Cycling and Soil Health:

Insects play a crucial role in nutrient cycling and soil health. Decomposers like beetles, ants, and earthworms break down organic matter, converting it into nutrient-rich soil (Adekunle *et al*., 2020). This natural process enhances soil fertility, benefiting crop growth and reducing the need for synthetic fertilizers. The economic significance lies in reduced fertilizer costs and improved long-term soil productivity (Ibe *et al*., 2019).

2.2.4 Silk Production:

Insects have a direct economic impact through products like silk. Silkworms, the larvae of the silk moth, produce silk threads that are used to create luxurious fabrics and textiles (Adegoke *et al*., 2019). Silk production is a significant industry in many countries, generating income and employment opportunities (Adebayo *et al*., 2021).

2.2.5 Alternative Protein and Livestock Feed:

Insects offer a sustainable solution to the growing demand for protein. Insect farming, or entomophagy, involves rearing insects for human consumption and animal feed (Oyeyemi *et al*., 2020). Insects like mealworms, crickets, and black soldier flies are rich in protein, vitamins, and minerals. As traditional livestock production faces challenges related to resource consumption and environmental impact, insects provide an economically viable and ecologically sound alternative protein source (Ajayi *et al*., 2021).

2.2.6 Biological Research and Bioinspiration:

Insects also contribute indirectly to agricultural innovation. Studying insect behavior, physiology, and genetics informs agricultural research, leading to advancements in pest management, crop breeding, and biotechnology (Durotoye *et al*., 2019). Moreover, bioinspiration, drawing inspiration from nature's solutions, has led to the development of new agricultural technologies and practices (Olufemi *et al*., 2021)

The economic importance of insects in agriculture cannot be overstated. Their roles in pollination, pest control, nutrient cycling, and even alternative protein production significantly impact crop yields, food security, and the agricultural industry's sustainability.

Recognizing and preserving the vital contributions of insects to agriculture are essential for maintaining global food production, supporting rural economies, and fostering sustainable farming practices.

2.3 THE ECONOMIC IMPORTANCE OF INSECTS IN MEDICINE

Insects, often viewed as pests or nuisances, play a surprising and critical role in the field of medicine. Their economic importance extends far beyond their negative aspects, as they contribute to various aspects of pharmaceuticals, research, and medical advancements. From providing novel compounds for drug development to aiding in wound healing and disease diagnostics, insects have carved out a unique niche in the realm of medicine.

2.3.1 Pharmaceutical Discovery and Drug Development:

Insects have been a treasure trove of bioactive compounds that serve as the foundation for drug development. Insects like ants, bees, and beetles produce a diverse array of secondary metabolites, some of which have shown promise in fighting cancer, bacterial infections, and inflammation (Bello, 2019).

2.3.2 Novel Therapies and Treatment Approaches:

Insects have inspired innovative therapies. Maggots, the larval form of certain flies, have been used in medical settings for centuries to aid in wound healing (Mochtar, 2020). Their ability to clean and debride necrotic tissue promotes faster healing and reduces infection risk. This approach, known as maggot therapy, continues to be effective in treating chronic and infected wounds that don't respond well to conventional treatments.

2.3.3 Disease Diagnosis:

Insects have also contributed to the development of disease diagnostic tools. The fruit fly, Drosophila melanogaster, has been extensively used as a model organism to study genetics and diseases (Osigwe *et al*., 2019). Its relatively simple genetic makeup has provided insights into human diseases such as cancer, neurodegenerative disorders, and heart diseases. Additionally, the gene-editing tool CRISPR, which has revolutionized genetic research, was inspired by the immune system of bacteria, including those found in insects (Oladiji *et al*., 2019).

2.3.4 Medical Research and Basic Science:

Insects have played a crucial role in advancing our understanding of fundamental biological processes. For instance, honeybees have been studied to gain insights into collective behavior, learning, and memory (Olayemi *et al*., 2019). These studies have implications not only for understanding bees but also for unraveling the complexities of human cognition and behavior.

2.3.5 Genetic Research and Transgenics:

Insects have been essential in genetic research, with the genetic modifications of insects helping us understand the function of specific genes and pathways (Obokoh *et al*., 2019). The study of transgenic fruit flies has provided insights into the role of genes in development, behavior, and disease (Ukegbu et al., 2020). This knowledge has applications in various medical fields, including understanding the genetic basis of human diseases

2.3.6 Biomimicry and Medical Device Innovation:

Insects have inspired the design of medical devices. The mosquito's proboscis, for example, has served as a model for creating micro-needles used for painless drug delivery and blood sampling (Onyenekwe *et al*., 2018). The properties of insect cuticles, which are strong yet lightweight, have influenced the development of biocompatible materials for surgical implants and prosthetics (Udeze *et al*., 2017).

The economic importance of insects in medicine transcends their reputation as mere pests. These small creatures have paved the way for novel drug discovery, innovative therapies, disease diagnostics, and advanced medical research. Through their unique attributes and contributions, insects continue to shape the landscape of medical science and open doors to new treatments and breakthroughs that benefit both human health and the economy.

2.4 INSECT PESTS

Insect pests are a pervasive and intricate facet of our natural world, exerting a remarkable influence on diverse ecosystems and human societies (De Groot, 2017). These remarkable creatures, often minuscule in size, wield an outsized impact that transcends their dimensions (Dress, 2009). Their existence prompts a complex interplay between humans, plants, animals, and the environment, resulting in significant challenges that demand innovative solutions. Insect pests, by definition, encompass species that exhibit behaviors, characteristics, or tendencies that bring about adverse effects on human interests, including but not limited to agriculture, health, and the overall ecological equilibrium (Akinnola *et al*., 2014).

Throughout human history, the relationship with insect pests has been a dichotomous one. On one hand, insects have vital roles as pollinators, recyclers of organic matter, and components of intricate food webs (Oluwamuyiwa *et al*., 2018). On the other, certain species have evolved traits that allow them to exploit human activities and resources, sometimes with devastating consequences. This duality underscores the dynamic nature of the interactions between humans and insects, often oscillating between cooperation and conflict (Makinde *et al*., 2019).

Insect pests play a particularly weighty role in the realm of agriculture. The rise of agriculture facilitated human civilization's advancement, but it also established a fertile ground for insect pests to thrive (Alemayehu *et al*., 2020). The evolving tactics of these pests, ranging from rapid reproduction to developing resistance against pesticides, have challenged farmers' ability to safeguard their crops. The battle between humans and these tiny adversaries has given rise to a constant search for innovative approaches to pest management. Insect pests' propensity to develop resistance highlights their adaptability, reminding us of the ongoing evolutionary competition between our species and these resilient creatures (Wafula *et al*., 2010)

It's important to note that insect pests are not confined to agricultural landscapes; they extend their impact into natural ecosystems as well. The introduction of non-native insect pests to new environments can trigger ecological disturbances with cascading consequences (Thomas *et al*., 2004). These invaders can disrupt established food chains, alter plant communities, and ultimately threaten the survival of native species. These instances underscore the vulnerability of ecosystems to unanticipated shifts caused by the introduction of foreign species, necessitating a comprehensive understanding of the ecological intricacies at play (Elton, 2000).

Insect pests are enigmatic agents of change that provoke a complex tapestry of interactions within our world. Their presence raises fundamental questions about the delicate equilibrium of ecosystems, human intervention, and the potential for unforeseen ramifications.

2.4.1 IMPACT OF INSECT PESTS ON AGRICULTURE

In the context of Nigeria and the broader West African region, insect pests wield a profound influence on agriculture, a cornerstone of the economy and a vital source of livelihood for millions. These pests, often inconspicuous in size, possess the capacity to unleash widespread havoc on crops, triggering a ripple effect that reverberates through communities and nations (Adeleke *et al*., 2014).

Nigeria, as one of the largest agricultural producers in West Africa, grapples with a diverse array of insect pests that afflict crops crucial to its sustenance. The maize stem borer (Busseola fusca), a notorious pest, tunnels into maize plants, causing yield losses that are felt by both smallholder farmers and commercial producers (Akande, 2020). In cassava cultivation, the cassava mealybug (Phenacoccus manihoti) can decimate entire cassava fields, jeopardizing food security and income streams for rural families. Similarly, the pod borer (Maruca vitrata) inflicts damage on cowpea plants, a vital source of protein for many communities (Ayinde *et al*., 2013).

In West Africa, cotton production is also at the mercy of insect pests. The cotton bollworm (Helicoverpa armigera) ravages cotton fields, leading to decreased cotton yields and diminished profits for cotton farmers (Babalola *et al*., 2016). Furthermore, the cocoa mirid bug (Sahlbergella singularis) poses a significant threat to cocoa production in countries like Ghana and Côte d'Ivoire, affecting the quality and quantity of cocoa beans, which are essential exports for these economies (Fasakin *et al*., 2017).

The impact of these insect pests extends beyond immediate crop losses. Pesticides are often employed to manage these pests, yet excessive pesticide use can harm the environment, contaminate water sources, and affect human health (El-Sayed *et al*., 2014). Additionally, the economic toll is substantial, with funds that could have been invested in other developmental activities being diverted towards pest management (Kareiva *et al*., 2008)

The impact of insect pests on agriculture in Nigeria and West Africa is undeniable, affecting staple crops and livelihoods. The resilience and resourcefulness of farmers in the face of these challenges highlight the importance of tailored strategies that harmonize with the region's complex ecosystems. By fostering a collaborative approach between researchers, policymakers, and farmers, a future of increased agricultural productivity and reduced pest-related losses can be envisioned for this vibrant region.

2.4.2 Some common insect pests that affect various food crops in Nigeria

•Cotton (*Gossypium spp*):

Cotton Bollworm (*Helicoverpa armigera*): Feeds on developing cotton bolls, causing damage and yield loss.

Cotton Aphids: Suck sap from cotton plants, leading to reduced growth and quality (Barber *et al*., 2014).

•Palm Fruit (*Elaeis guineensis*)

Red Palm Weevil (*Rhynchophorus ferrugineus*): Infests palm trees, damaging the crown and causing the tree to collapse.

African Oil Palm Beetle (*Elaeidobius kamerunicus*): Feeds on flowers, reducing fruit set and oil production (Olatunji *et al.*, 2019).

•Rice (*Oryza sativa*):

Rice Stem Borers: Larvae bore into rice stems, affecting plant health and reducing yield.

Rice Hispa (*Dicladispa armigera*): Damages rice leaves by feeding on them, leading to reduced photosynthesis (Egwu *et al*., 2018)

•Corn (*Zea mays*):

Fall Armyworm (*Spodoptera frugiperda*): Feeds on maize leaves, causing widespread damage.

Maize Weevils: Infest stored maize, leading to post-harvest losses (Ibrahim *et al*., 2018).

•Yam (*Dioscorea* spp):

Yam Beetle (*Heteroligus* spp.): Damages yam leaves by feeding on them.

Yam Moth (*Loxostege* spp.): Larvae bore into yam tubers, causing spoilage (Shokunbi *et al*., 2019).

•Beans (*Phaseolus vulgaris*):

Bean Aphids: Suck sap from bean plants, leading to stunted growth and reduced yield.

Bean Leaf Beetles: Feed on bean leaves, causing defoliation (Ani *et al*., 2016).

•Cassava (*Manihot spp.)*:

Cassava Green Mite (*Mononychellus tanajoa*): Feeds on cassava leaves, leading to reduced growth.
Cassava Bacterial Blight: Bacterial infection that causes lesions on cassava leaves and stems (Owuor *et al*., 2017).

•Sugarcane *(Saccharum officinarum*):
Sugarcane Borers: Larvae bore into sugarcane stalks, causing damage and yield loss.
Sugarcane Aphids: Suck sap from sugarcane plants, leading to reduced growth (Otim *et al*., 2018).

2.5 METHODS OF CONTROLLING INSECT PESTS

Effective control of insect pests is crucial for ensuring healthy crops, safeguarding human health, and maintaining ecological balance. Various methods are employed to manage insect pests, each with its own advantages, disadvantages, and ecological implications. Here, we'll explore different methods of controlling insect pests:

2.5.1 Cultural methods of pest control

Cultural methods of pest control harness ecological principles and traditional practices to manage pests in agricultural and gardening settings (Bakare *et al*., 2021). These techniques rely on altering the environment in ways that discourage pest populations or favor the activities of natural predators and beneficial organisms (Mohammed *et al*., 2019). Cultural methods are sustainable, often cost-effective, and contribute to long-term pest management. Here's an in-depth look at these methods:

i. Crop Rotation:

Crop rotation involves systematically changing the type of crop grown in a particular field each planting season. This disrupts pest life cycles, as pests that target one crop may not find their preferred host in the next cycle (Ayeni *et al*., 2021). Crop rotation also helps improve soil health and reduce the buildup of pests and diseases associated with specific crops (Adejumo *et al*., 2018).

ii. Polyculture and Mixed Cropping:

Planting multiple crop species in close proximity, also known as polyculture or mixed cropping, can deter pests (Daramola *et al.*, 2019). The diversity of plant species disrupts pest patterns by creating a less favorable environment for specialized pests. Additionally, certain plant combinations can attract natural enemies, enhancing biological control (Balogun, 2018).

iii. Trap Crops:

Trap crops are sacrificial plants that are highly attractive to pests. By planting these crops strategically, pests are drawn away from main crops, reducing damage. Trap crops can be especially effective in diverting pests that are early colonizers or have specific preferences (Olaogun *et al.*, 2018).

iv. Cover Crops and Mulching:

Cover crops and mulches are vegetation or materials placed over soil. They help suppress weed growth, which can serve as hosts for pests, and create a barrier that discourages pest movement (Oladunni *et al.*, 2021). Mulches can also regulate soil temperature and moisture, benefiting plants while hindering pest development (Olanrewaju *et al.*, 2020).

v. Sanitation and Hygiene

Good sanitation practices involve removing plant debris, weeds, and other materials that may harbor pests and diseases (Adebowale *et al.*, 2021). Proper disposal of plant residues reduces the chances of pest reinfestation. Regularly cleaning equipment, tools, and containers also helps prevent disease transmission (Idowu *et al.*, 2020).

vi. Cultural Timing:

Planting and harvesting crops at specific times can influence pest prevalence. Early planting can help crops establish before pest populations surge. Delayed planting may avoid periods of peak pest activity. Similarly, timing harvests to coincide with low pest populations can reduce the risk of infestation during storage (Gbadebo *et al.*, 2021).

vii. Resistant Varieties:

Planting crop varieties that are naturally resistant to specific pests can be highly effective. Resistant plants deter pests through physical, chemical, or genetic mechanisms. Breeding programs aim to develop and promote resistant varieties that align with local pest pressures (Olaniyan *et al.*, 2020).

viii. Site Selection and Layout:

Choosing planting sites that minimize exposure to prevailing winds, moisture, and other factors that encourage pests can help reduce their impact. Proper spacing between plants promotes air circulation, making the environment less favorable for disease development (Ashiwaju *et al*., 2020).

ix. Crop Diversity and Ecosystem Enhancement:

Integrating native plants, hedgerows, and beneficial insect-attracting flowers into agricultural landscapes can create habitats for natural enemies of pests. These elements support a diverse ecosystem that contributes to pest control (Babatola *et al*., 2021).

Cultural methods of pest control are context-specific and often require understanding local ecosystems, pest dynamics, and agricultural practices. Their effectiveness is maximized when integrated into a holistic pest management strategy that considers multiple approaches, such as biological control and judicious pesticide use (Ajayi *et al*., 2020). By emphasizing long-term sustainability and reducing reliance on chemical inputs, cultural methods contribute to healthier crops, reduced environmental impact, and more resilient agricultural systems.

2.5.1.1 Specific insect pests and the corresponding cultural methods suitable for controlling them

i. Cabbage Worm (Imported Cabbageworm, Diamondback Moth, etc.):

These pests damage cabbage family crops like cabbage, broccoli, and cauliflower.

Cultural Method: Companion Planting (Polyculture)

Planting aromatic herbs like thyme, oregano, and rosemary alongside cabbage can deter cabbage worms. These herbs release strong scents that repel the pests. Additionally, planting nasturtiums nearby can attract beneficial insects that feed on cabbage worms.

ii. Aphids:

Aphids are common sap-sucking pests that attack a wide range of plants, including roses and vegetables.

Cultural Method: Natural Enemies and Trap Crops

Planting flowers like marigolds and nasturtiums near aphid-prone plants can act as trap crops, drawing aphids away from the main crops. Additionally, encouraging natural enemies like ladybugs and lacewings through habitat enhancement can help control aphid populations (Adeosun *et al*., 2021).

iii. Squash Bug:
These pests feed on squash and pumpkin plants, causing wilting and damage to leaves.
Cultural Method: Timing of Planting
Planting squash crops early in the season can help them establish and grow before squash bug populations peak. By the time the pests become abundant, the plants are more resilient and better able to withstand the damage (Oni *et al*., 2022).

iv. Bean Beetle (*Callosobruchus maculatus*):
These beetles feed on bean plants, leaving behind skeletonized leaves.
Cultural Method: Companion Planting (Polyculture)
Interplanting beans with crops like potatoes can deter Mexican bean beetles. The beetles are less attracted to potatoes and are more likely to move away from bean plants (Ogunnaike *et al*., 2019).

v. Fruit Flies (*Bactrocera spp*.):
Fruit flies infest various fruits, causing damage and reducing market value.
Cultural Method: Sanitation and Removal of Fallen Fruits
Removing fallen or infested fruits from the ground and trees can reduce the breeding sites for fruit flies and break their life cycle.

Cultural methods require an understanding of the pest's biology and life cycle, as well as careful planning and implementation (Bakare *et al*., 2021). Combining these methods with other pest management strategies can create a comprehensive and effective approach to controlling insect pests

2.5.2 BIOLOGICAL CONTROL FOR PEST MANAGEMENT

Biological control is a sustainable and environmentally friendly approach to pest management that utilizes natural enemies, such as predators, parasitoids, and pathogens, to regulate pest populations (Akintayo, 2018). This method takes advantage of the intricate relationships that exist in ecosystems, where organisms have evolved mechanisms to keep pest populations in check.

2.5.2.1 TYPES OF BIOLOGICAL CONTROL

1. Predatory Insects:

Predators are organisms that feed directly on pest species. Examples include ladybugs, lacewings, and spiders. These insects target various life stages of pests, preventing their proliferation and reducing damage to crops (Oladele, 2018).

2. Parasitoids:

Parasitoids are insects that lay their eggs on or in a host pest. The developing parasitoid larvae consume the host, ultimately killing it. Common examples include tiny wasps that parasitize caterpillar pests like tomato hornworms (Ilesanmi, 2019).

3. Pathogens:

Pathogens are disease-causing microorganisms that can be used to control pests. Microbial pathogens like bacteria, viruses, and fungi can infect and kill specific pest species while sparing non-target organisms (Akinyi, 2019).

4. Nematodes:

Certain nematodes are parasitic to insects. When introduced into the soil, these nematodes infect and kill insect larvae by releasing bacteria that break down the host's tissues (Chigbu, 2018).

5. Augmentation and Conservation:

Augmentation involves releasing large numbers of natural enemies to suppress pest populations. Conservation focuses on creating habitats that support the populations of existing natural enemies, ensuring their long-term presence (Oke, 2020).

2.5.2.2 Advantages Of Biological Control:

•Environmentally Friendly: Biological control reduces reliance on chemical pesticides, minimizing environmental contamination and preserving beneficial organisms

•Targeted Action: Biological control agents often target specific pests, sparing non-target species. This precision minimizes disruption to ecosystems (Ojora, 2020).

•Sustainability: Biological control provides long-term solutions, as natural enemies can persist in the environment and self-regulate pest populations (Egunjobi, 2019).

•Reduced Resistance Risk: Unlike chemical pesticides, biological control agents have diverse modes of action, making it less likely for pests to develop resistance (Tunde-Olowu, 2018).
•Integrated Approach: Biological control complements other pest management tactics, such as cultural practices and chemical interventions, within integrated pest management (IPM) strategies (Adewale, 2018).

2.5.2.3 Challenges and Considerations:
•Effectiveness and Timing: The success of biological control depends on factors like environmental conditions and pest densities. It may take time for natural enemies to establish and exert control (Badmus, 2019).
•Non-Target Effects: Careful consideration is needed to ensure that introduced biological control agents do not harm native species or disrupt local ecosystems (Adebayo, 2020).
•Research and Monitoring: Adequate research is essential to identify appropriate natural enemies for specific pests. Ongoing monitoring is necessary to assess the effectiveness of biological control (Alabi, 2019).

Biological control is a powerful tool in pest management, promoting ecological balance and reducing the reliance on chemical interventions. By harnessing the natural interactions between organisms, this approach contributes to sustainable agriculture, healthier ecosystems, and safer food production.

2.5.2.4 Specific insect pests in Nigeria that could benefit from biological control
i. African Armyworm (*Spodoptera exempta*):
This pest affects a wide range of crops, including cereals like maize and millet. Large outbreaks can lead to severe defoliation and crop losses.
Biological Control: Parasitoid Wasps
Parasitoid wasps like *Cotesia flavipes* are natural enemies of African armyworm. They lay eggs on the armyworm larvae, and the emerging wasp larvae eventually kill the pest (Awoniyi, 2021).

ii. Cotton Bollworm (*Helicoverpa armigera*):
A notorious pest of cotton and other crops, the cotton bollworm damages reproductive structures and reduces yield.
Biological Control: Trichogramma Wasps

Trichogramma wasps are tiny parasitoids that lay their eggs in the eggs of pests like cotton bollworm. The wasp larvae develop within the pest eggs, reducing their numbers (Lawal, 2019).

iii. Yam Beetle (*Heteroligus spp.*):

Yam beetles feed on yam leaves, affecting yam production and quality.

Biological Control: Ladybugs (Predators)

Ladybugs, such as *Harmonia axyridis*, are voracious predators that feed on aphids and other soft-bodied pests, including yam beetles (Ololade, 2018).

iv. Maruca Pod Borer (*Maruca vitrata*):

A significant pest of cowpea (beans), the maruca pod borer damages the pods, reducing yield and quality.

Biological Control: Egg Parasitoid (*Apanteles taragamae*). The egg parasitoid *Apanteles taragamae* lays its eggs on maruca eggs. As the parasitoid larvae develop, they consume the maruca eggs, reducing pest populations (Bamisaye, 2020).

v. Mango Fruit Fly (*Bactrocera invadens*):

This pest attacks various fruit crops, including mangoes, causing economic losses due to fruit damage and trade restrictions.

Biological Control: Parasitoid Wasps

Parasitoid wasps such as *Fopius arisanus* are used to control fruit flies. They lay their eggs inside fruit fly larvae, leading to their death (Manrakpam, 2021).

For successful biological control, thorough research, monitoring, and appropriate introduction of natural enemies are necessary. Local ecological factors and the life cycle of the pests should be considered to ensure that the chosen biological control agents effectively regulate pest populations without causing unintended consequences.

2.5.3 MECHANICAL AND PHYSICAL METHODS OF PEST CONTROL

Mechanical and physical methods of pest control involve using physical barriers, traps, and other non-chemical means to prevent or reduce pest infestations (Gassama, 2019). These approaches are often eco-friendly, targeting pests directly without posing significant risks to the environment, humans, or non-target organisms.

2.5.3.1 TYPES OF MECHANICAL AND PHYSICAL METHODS

1. Traps and Barriers:

Traps and barriers are devices that physically capture or deter pests. They are particularly effective for monitoring and managing pest populations (Stough, 2019).

- Sticky Traps: These traps coated with a sticky substance attract and immobilize pests, such as flying insects like fruit flies or whiteflies (Benkeblia, 2021).
- Pheromone Traps: Emit synthetic insect pheromones to lure pests into traps. Used to monitor pest populations and for mass trapping (Adeoye, 2018).
- Yellow Traps: Yellow-colored sticky traps are attractive to many flying insects, helping control pests like aphids, thrips, and whiteflies.
- Row Covers: Physical barriers placed over plants prevent pests from accessing them while still allowing sunlight, air, and water to reach the plants (Gassama, 2019).
-

2. Handpicking and Pruning:

Removing pests by hand, especially for small-scale gardens, can be effective for controlling certain pests. (Haldane, 2020).

- Handpicking: Physically removing pests like caterpillars, beetles, and snails from plants.
- Pruning: Removing infested plant parts, like leaves or branches, to prevent pest spread and to encourage plant health.

3. Mechanical Disruption:

These methods disrupt pest behavior and prevent them from establishing and reproducing. (Brenner, 2019).

- Tilling: Turning over soil disrupts pest life cycles by exposing pests to predators and harsh environmental conditions.
- Mowing: Regular mowing of lawns can reduce habitat for pests and discourage infestations.

4. High-Pressure Water Spray:

Using a strong jet of water to dislodge and remove pests from plant surfaces.

5. Beneficial Insects and Animals:

Introducing or encouraging natural enemies can be considered a form of biological control, but it also has mechanical aspects. (Nordlund, 2018).

- Predatory Insects: Releasing or encouraging insects like ladybugs and lacewings that feed on pests (Jackson, 2021).
- Birds and Bats: Providing nesting sites for birds and bats can attract natural predators that help control pest populations (Morales, 2019).

2.5.3.2 Advantages of Mechanical and Physical Methods

i. Environmentally friendly: Minimal or no use of chemicals reduces environmental impact (Sosnowski, 2021).

ii. Targeted action: Specific pests are directly affected, minimizing harm to non-target species (Adams, 2020)

iii. Sustainable: Mechanical methods often have a long-lasting impact and can be integrated into larger pest management strategies (Sosnowski, 2021).

2.5.3.3 Challenges and Considerations:

i. Labor-Intensive: Some methods, such as handpicking, may be labor-intensive and impractical for large-scale farming.

ii. Monitoring: Regular monitoring is essential to determine the effectiveness of traps and other devices.

iii. Specificity: These methods may not work for all pests or situations and should be combined with other control measures for optimal results.

Mechanical and physical methods of pest control offer practical, environmentally responsible alternatives to chemical interventions. Their effectiveness varies based on factors like pest type, pest population levels, and the scale of farming or gardening operations. When integrated with other pest management techniques, these methods contribute to sustainable and balanced pest control strategies.

2.5.3.4 Specific examples of insect pests that can be controlled using mechanical methods

i. Hornworms (*Manduca spp.*):
Tomato and tobacco hornworms are large caterpillars that feed on tomato, tobacco, and pepper plants.
Mechanical Method: Handpicking
Physically remove hornworms from plants. Look for the characteristic damage they cause, such as defoliation, and wear gloves to avoid their spiky "horn" (Jones, 2020).

ii. Whiteflies (*Bemisia spp*.):
Whiteflies are sap-sucking insects that damage many ornamental and vegetable crops.
Mechanical Method: Vacuuming
Using a small hand-held vacuum, gently suck up adult whiteflies from the undersides of leaves. This can help reduce their numbers and minimize damage (Ribera, 2020).

Remember that while mechanical methods can be effective for small-scale gardening or localized infestations, they may be less practical for larger agricultural operations. Integrating mechanical methods with other pest control strategies, such as cultural practices and biological control, can enhance their effectiveness and contribute to comprehensive pest management (Smith, 2018).

2.5.4 CHEMICAL METHODS OF PEST CONTROL

Chemical methods of pest control involve the use of chemical substances, known as pesticides, to manage and reduce pest populations (Hance, 2019). These substances target pests directly or interfere with their life cycles, aiming to minimize damage to crops, landscapes, and structures. While chemical methods are effective in certain situations, they should be used judiciously and responsibly to minimize potential environmental and health risks (Smith, 2020).

2.5.4.1 TYPES OF PESTICIDES

1. Insecticides: Target insects by disrupting their nervous system, digestion, or reproductive processes. They come in various forms, including sprays, baits, and systemic treatments (Johnson, 2019).

2. Herbicides: Designed to control weeds that compete with crops for resources. They can be selective (target specific plant types) or non-selective (affect a wide range of plants) (Owen, 2020).

3. Fungicides: Used to prevent and treat fungal diseases that can damage crops. Fungicides often act by inhibiting fungal growth and reproduction (Turner, 2018).

4. Rodenticides: Designed to control rodents like rats and mice. They are used to prevent damage to crops, structures, and potential disease transmission (Johnson, 2019).

2.5.4.2 Advantages of Chemical Methods:

•Rapid Action: Chemical methods often provide quick control over pest populations, preventing immediate damage (Johnson, 2021).

•Broad Spectrum: Some chemicals have a wide range of effectiveness, making them useful for controlling multiple pests (Johnson, 2021).

•Predictable Results: When used correctly, chemical methods can offer consistent and predictable outcomes (Turner, 2019).

•Scalability: Chemical methods can be adapted to different scales, from small gardens to large agricultural fields (Patel, 2020).

2.5.4.3 Challenges and Considerations:

•Environmental Impact: Chemicals can harm non-target organisms, disrupt ecosystems, and accumulate in the environment (Brown, 2019).

•Pest Resistance: Repeated use of the same chemicals can lead to pest populations developing resistance, rendering the chemicals ineffective (Johnson, 2018).

•Health Concerns: Pesticides can pose risks to human health through exposure during application, consumption of treated produce, and residues in the environment (Smith, 2021).

•Persistence: Some chemicals have long residual effects, remaining in the environment for extended periods (Johnson, 2018).

•Regulation and Safety: Proper handling, storage, and disposal of pesticides are essential to prevent accidents and protect human health (Smith, 2021).

2.5.4.4 Examples of insecticides, herbicides, and fungicides used in Nigeria, along with the specific pests or problems they are designed to control:

i. Insecticides:

•Insecticide: Lambda-Cyhalothrin

Pests Controlled: Various insects including mosquitoes, flies, aphids, and caterpillars.

Usage: Used in public health programs to control disease-carrying mosquitoes and in agriculture to manage a range of crop-damaging pests (Rice *et al*., 2003).

•Insecticide: Diazinon

Pests Controlled: Soil-dwelling insects like termites, grubs, and caterpillars.

Usage: Applied to the soil to protect crops, lawns, and trees from underground pests (EPA, 2000).

•Insecticide: Abamectin

Pests Controlled: Spider mites, leaf miners, and other chewing and sucking insects.

Usage: Used in agriculture to control a variety of pest species on crops like vegetables and fruits (Meng *et al*., 2016).

ii. Herbicides:

•Herbicide: Glyphosate

Pests Controlled: Broad-spectrum weed control, targeting grasses and broadleaf weeds.

Usage: Used in various crops, including maize, cassava, and soybeans, to control weeds and improve crop yields (Federle *et al*., 2019).

•Herbicide: Paraquat

Pests Controlled: Broad-spectrum weed control in various crops.

Usage: Used to manage weeds in crops like rice, sugarcane, and cotton (WHO, 2021).

•Herbicide: 2,4-D (2,4-Dichlorophenoxyacetic acid)

Pests Controlled: Broadleaf weeds in cereals and pasture grasses.

Usage: Applied to control weeds in crops like maize and sorghum and to manage weeds in non-crop areas (Sexton *et al*., 2017).

iii. Fungicides:

•Fungicide: Mancozeb

Pests Controlled: Various fungal diseases, including late blight in tomatoes and potatoes.

Usage: Used to protect a wide range of crops, including vegetables, fruits, and ornamentals, from fungal diseases (Balusu *et al*., 2019).

•Fungicide: Propiconazole

Pests Controlled: Fungal diseases like rusts, leaf spots, and powdery mildew.

Usage: Applied to manage fungal diseases in crops like cereals, fruits, and ornamental plants (Panwar *et al*., 2020)

•Fungicide: Copper-based Fungicides

Pests Controlled: Bacterial and fungal diseases in crops like vegetables and fruits.

Usage: Used in organic farming and conventional agriculture to control diseases like bacterial blight and downy mildew (Dong *et al*., 2018).

It's important to note that the effectiveness of these chemicals can vary based on factors such as pest populations, local conditions, and proper application techniques.

2.5.5 INTEGRATED PEST MANAGEMENT (IPM)

Integrated Pest Management (IPM) is a holistic and sustainable approach to managing pest populations that aims to minimize the economic, environmental, and health risks associated with pest control (Adewale, 2018). IPM emphasizes a combination of multiple strategies to maintain pest populations at levels that do not cause significant economic or ecological harm. This comprehensive approach takes into consideration the complex interactions between pests, their natural enemies, crops, and the environment

2.5.5.1 KEY COMPONENTS OF IPM

•Monitoring and Scouting: Regular and systematic monitoring of pest populations helps determine if and when control measures are necessary. This involves assessing pest levels, crop health, and potential economic impact (Pedigo, 2004).

•Thresholds: IPM sets action thresholds, which are predetermined pest population levels that trigger the need for control measures. Treatment is only initiated when pest populations exceed these thresholds (Howard, 2004).

•Cultural Practices: Cultural methods that alter the environment to discourage pests are a cornerstone of IPM. These practices include crop rotation, companion planting, and habitat manipulation to enhance natural enemies (Bakare, 2021).

•Biological Control: Encouraging and releasing natural enemies, such as predators, parasitoids, and beneficial insects, to keep pest populations in check is a fundamental aspect of IPM (Ojora, 2020).

•Chemical Control: Chemical methods, such as insecticides and fungicides, are used judiciously and selectively when other strategies are insufficient. IPM prioritizes reduced-risk and targeted pesticides (Smith, 2020).

•Physical and Mechanical Control: Physical barriers, traps, and mechanical methods like handpicking and vacuuming are employed to directly control pests without chemical interventions (Adeoye, 2018).

•Genetic Control: Genetic approaches, like releasing sterile insects or cultivating pest-resistant crop varieties, are integrated into IPM strategies to manage pest populations (Kumar *et al*., 2017).

•Education and Decision-Making: Educating farmers, growers, and agricultural professionals about IPM principles empowers them to make informed decisions based on ecological knowledge and risk assessments (Costa *et al*., 2020).

2.5.5.2 Advantages of IPM

i. Reduced Environmental Impact: By minimizing chemical use and promoting natural balances, IPM reduces harm to non-target organisms, water sources, and ecosystems (Miller *et al*., 2015).

ii. Economic Benefits: IPM can lead to cost savings through reduced chemical inputs, improved crop yield, and lowered pest-related losses (Lawton, 2003).

iii. Resistance Management: Rotating control methods and using diverse tactics help prevent pest populations from developing resistance to specific treatments (Futuyuma, 2011).

iv. Long-Term Sustainability: IPM maintains the health and productivity of ecosystems, preserving resources for future generations (Lawton, 2003).

v. Health and Safety: Reduced pesticide exposure benefits both farmworkers and consumers, promoting human well-being (EPA, 2020).

2.5.5.3 Challenges and Considerations

i. Complexity: Implementing IPM requires a deep understanding of pest biology, natural enemies, and local conditions (Kogan, 2012).

ii. Educational Efforts: Farmers and practitioners need to be educated about IPM principles and techniques to effectively implement the approach (Franzel *et al*., 2019).

iii. Monitoring and Adaptation: Regular monitoring is crucial for timely decision-making, and strategies may need adjustment based on changing pest dynamics (Barrows, 2001).

IPM is a dynamic and flexible approach that can be adapted to various agricultural systems, from small-scale subsistence farming to large commercial operations. By combining diverse strategies and applying them judiciously, IPM achieves effective pest management while promoting ecological balance, economic viability, and human health (Adewale, 2018).

CHAPTER THREE
MATERIALS AND METHODS

3.1 STUDY AREA

Badagry is a coastal town and Local Government Area (LGA) in Lagos State, Nigeria. It is quite close to the city of Lagos, and located on the north bank of Porto Novo Creek, an inland waterway that connects Lagos (Nigeria's largest city and economic capital) to the Beninese capital of Porto-Novo. The same route connects Lagos, Ilaro, and Porto-Novo, and shares a border with the Republic of Benin. As of the preliminary 2006 census results, the municipality had a population of 241,093. It is known for its rich history as a major center for the transatlantic slave trade during the 18^{th} and 19^{th} centuries. Badagry's history dates back to ancient times, and it has evolved through various stages. The region was originally inhabited by the Awori people, a sub-ethnic group of the Yoruba tribe. The town's strategic coastal location led to its prominence as a center for trade and commerce, attracting various ethnic groups and foreign traders. In the 15^{th} century, the Portuguese were among the first Europeans to establish contact with Badagry, setting up trade relations. Over time, Badagry became a significant port for the transatlantic slave trade during the 18^{th} and 19^{th} centuries. This dark period in its history saw thousands of slaves being captured, held captive, and shipped to the Americas and Europe.

In 1863, the British declared Badagry a colony and took control of the town, ending the slave trade. During Nigeria's colonial period, Badagry was part of the Lagos Colony, and it played a vital role in the struggle for independence. Today, it has become a significant cultural and tourist destination, with several historical sites, museums, and monuments that commemorate its past. Badagry has a land area of approximately 72 square kilometers (about 27.8 square miles). Regarding the indigenes, the people native to Badagry are primarily from the Awori and Egun ethnic group, which are sub-ethnicities of the Yoruba people. The Awori and Egun people have a unique cultural heritage and have been an integral part of the town's history and development.

The major occupations of the indigenes of Badagry are diverse and reflect the region's economic activities. Some of the main occupations include:
Fishing: Badagry's coastal location makes fishing a significant occupation for many residents. The town's proximity to the Atlantic Ocean provides opportunities for both traditional and commercial fishing activities.
Farming: Agriculture is another essential occupation in Badagry. The fertile land in the area supports the cultivation of various crops, including cassava, yam, plantain, and vegetables.

Trading and Commerce: Badagry has historically been a trading center, and this tradition continues today. Many indigenes are involved in various trade activities, including the sale of local produce, crafts, and other goods.

Tourism: Due to its historical significance and cultural heritage, tourism has grown in importance in Badagry. The town attracts both local and international tourists, creating job opportunities in hospitality, tour guiding, and related services.

Art and Crafts: The indigenes of Badagry have a rich artistic tradition, and many are skilled in creating traditional crafts, such as wood carvings, beadwork, and textiles.

Badagry comprises several villages and communities. Some of the notable villages in Badagry include: Ikoga Zebbe, Mowo, Ibereko, Iragon, Atinporomeh, Igborosun, to mention a few.

Figure 1: Map of Nigeria

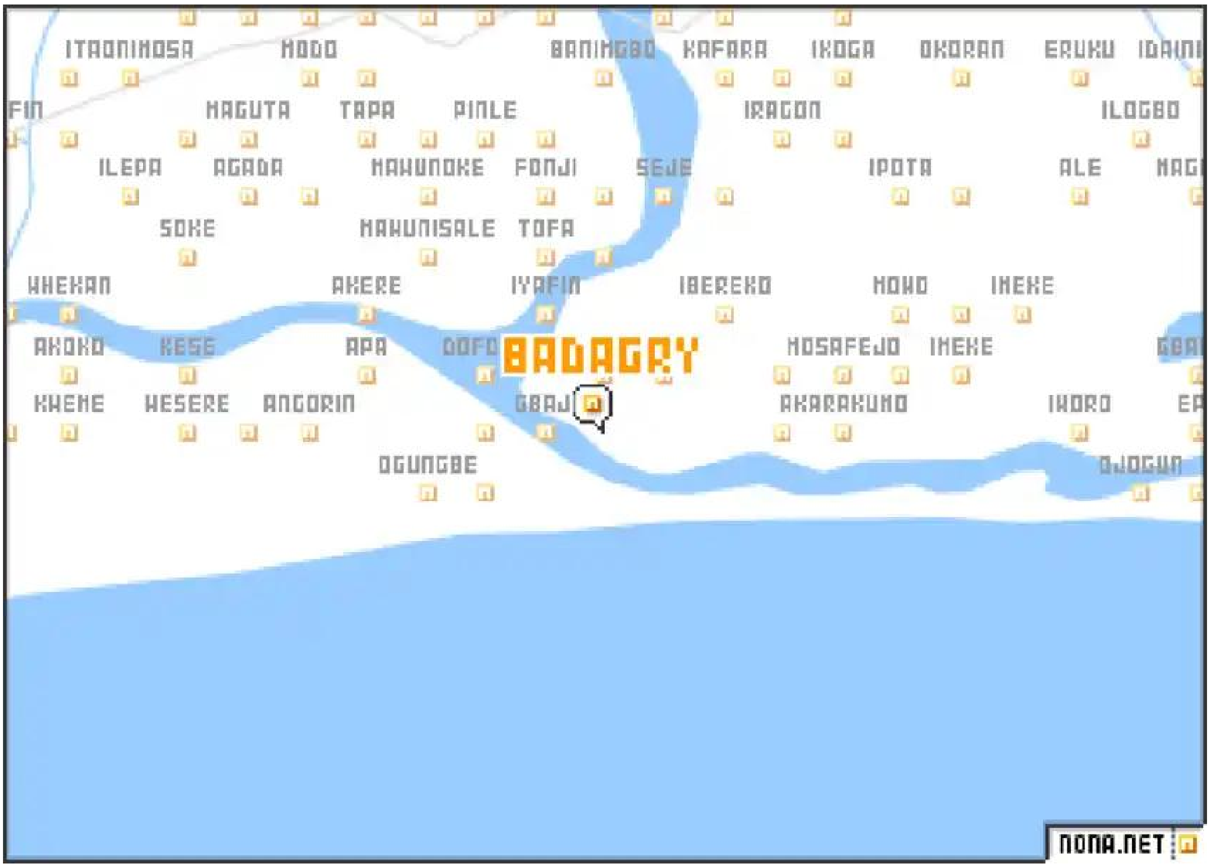


Figure 2: Map of Badagry LGA showing various villages.

3.2 Insect Pests Management Survey

The survey was conducted between May and June 2023, using semi-structured questionnaires to elicit information from indigenous people of Ikoga Zebbe, Igborosun and Mowo villages in Badagry Local Government Area. Visits were made to villages in the area to interview farmers and locals on their knowledge of insects and their methods of minimizing their effects on crops. Before each interview was conducted, I introduced myself and asked the informants for their permission to take notes of vital information they were providing. Children and teenagers under 20 years were excluded from the survey. All age groups interviewed fell between 20 and 69 years. The interviews were conducted either in English language, Pidgin English or in the native language (Egun) as a fair number of respondents do not understand English. Specifics communities in the three villages surveyed included Javie, Soldier's quarters, Masenoh, Igborosun, Oko agbon, Iragon and Aocoed Estate. The questionnaires were not evenly distributed among the communities due to reduced population as most of the residents have relocated to the cities. The questionnaires had five key sections and collected information on: (1) demographics of the respondent; (2) questions relating to their basic knowledge of insects pests and management methods (3) questions relating to their specific management methods of insect pests; (4) comparisons between the management methods they are familiar with; (5) opinions and preferences.

Plate 1: Pictorial representation of common Insects.

Plate 2: A respondent in Ikoga village during the survey

CHAPTER FOUR

RESULTS

4.1 Demographic information

Of the total respondents who were interviewed 83.33% were males and 16.67% were females out of which 10% were males were between 21-30 years, 10% were males were between 31-40 years, 6.67% were females and 26.67% were males were between 41-50 years, 10% were females and 23.33% were males between 51-60 years and 13.33% were males between 61-70 years (Figure 3). Of the respondents 6.67% had been farming for less than a year, 33.33% had been farming for 1-5 years, 16.67% had been farming for 10-15 years and 6.67 had been farming 16 years and above (Figure 5).

4.2 Knowledge of insect pest and control methods

All respondents said they knew what insect pests were and can identify insect pests. On the control methods used to control insect pests the respondents varied on the control methods they employed (Figure 5-6). Of the respondents 36.67% reported using chemical control, 16.67% reported using biological control, 33.33% reported using mechanical control and 60% reported using cultural control methods (Figure 5). Of the respondents 50% reported using only one method, 33.33 used two methods, 6.67% used 3 methods (Figure 6) out of which 3.33% reported using biological control, 10% reported using mechanical control, 20% reported using cultural control, 16.67% reported using chemical control, 10% reported using chemical and cultural control, 10% reported using cultural and mechanical control, 6.67% reported using mechanical and chemical control, 3.33% reported using biological and mechanical, 3.33% reported using cultural and biological control, 3.33% reported using mechanical, cultural and biological control and 3.33% reported using chemical, cultural and biological control (Table 1).

4.3 Control Methods

Different chemicals were found to be used to control pests (Table 2). Of the respondents 3.33% reported using atrazine four times a year, 3.33% reported using atrazine twice a year and 3.33% reported using atrazine three times a year. 3.33% abamectin six times a year, 3.33% reported using abamectin once a year and 3.33% reported using abamectin four times a year. Of the respondents 3.33% reported using chlorpyrifos 3 times a year and six times a year respectively. 3.33% reported using cypermethrin three times a year, 3.33% reported using glyphosate three times a year, 3.33% reported using malathion 4 times a year and 3.33% reported using spinosad twice a year. The different biological control methods used were recorded (Table 3). About 3% of the respondents reported using biopesticides twice a year while 6.67% reported using biopesticides four times a year. 3.33% reported using toads to control pests three times a year and 3.33% reported using neem oil as control twice a year. Different cultural control methods were found to be employed in controlling pests (Table 4). Of the respondents 3.33% said they used crop rotation method every three years while 3.33% said they did crop rotation every 5 years. Of the respondents 3.33% said they did early planting every four years to control pests while 3.33% said they did early harvesting every year. 3.33% said they did mixed cropping every 2 years to control pests while 6.67% said they did mixed cropping yearly to control pests. 6.67% said they planted disease resistant crops every planting season to control pests. 3.33% said they did sanitation every 2 months while 6.67% said they did sanitation every 2 weeks and 10% said they sanitation monthly to control pests. The different mechanical control methods used were recorded. Different mechanical controls were found to be used by the respondents (Table 5). Of the respondents 3.33% of the respondents reported using barricades always while 10% reported using barricades always to control pests. 3.33% reported handpicking often to control pests and 3.33% reported using nets as control rarely. 3.33% of the respondents reported using traps often while 6.67% reported using traps rarely to control pests. 3.33% reported using traps and hand picking often to control pests. Respondents were found to be combining different control methods (Figure 5). Of the respondents 50% reported using only one method of control, 33.33% reported combining 2 methods of control and 6.67% reported using 3 methods of control together. Of those who reported using only one method 3.33% reported using biological control, 16.67% reported using chemical control, 20% reported using cultural control and 10% reported using mechanical control method. Of those who reported combining two methods 3.33% reported combining biological and mechanical control, 10% reported combining chemical and cultural control, 6.67% reported combining chemical and mechanical control, 3.33% reported combining cultural and biological and 10% reported combining cultural and mechanical control to control pests. Of those who reported combing 3 methods 3.33% reported combining chemical, cultural and biological and 3.33% reported combining mechanical, cultural and biological control methods.

4.4 Perception of the control methods

Perception of respondents on the implementation of different control methods varied (Figure 6). Of the total respondents 23.33% reported that chemical control was the easiest to implement while 6.67% said it was the hardest to implement. Of the total respondents 6.67% reported that cultural control was the easiest to implement while 33.33% said it was the hardest to implement. 6.67% said biological control was the easiest while 3.33% said it as the hardest control method to implement. Of the total respondents 10% said that mechanical control was the easiest to implement. Opinions of respondents on the cost of different control methods varied (Figure 7). 43.33% of the respondents said chemical control was the most expensive control method while 50% of the respondents said cultural control was the cheapest control method. Of the total respondents 10% said that biological control was the cheapest to implement while 3.33% said that it was the most expensive control. Of the total respondents 10% said that biological control was the cheapest to implement while 3.33% said that it was the most expensive control. Of the respondents 20% said that mechanical control was the cheapest to implement while 3.33% said that it was the most expensive control.

Perception of respondents on the most effective control method varied (Figure 8). Of the respondents 33.33% reported that chemical control was the most effective control method, 16.67% reported that cultural method was the most effective, while 16.67% said that biological control was the most effective control method and 3.33% reported that mechanical control was the most effective control method. When asked whether they will use a biopesticide that is very effective 53.33% said they would use it while 46.67% said they would not.

Control methods preferred by the respondents according to farm size varied (Figure 11). Respondents with large farms said they used chemical control (75%) and biological control (25%) (Figure 9a). Respondents with small farms said they used mechanical control (16.7%), biological control (16.7%), cultural control (16.7%) and 50% don't use any form of control (Figure 9b). Respondents with average farms said they used mechanical control (8.3%), biological control (8.3%), chemical control (25%), cultural control (25%) and 33.3% said they don't use any form of control (Figure 11c). Respondents preferred control methods and their impact on yield varied (Table7). Biological control and chemical control increased yield. Mechanical control methods used were weeding which made no difference in yield and barriers which increased yield. Cultural control methods used were early planting which increased yield and mixed cropping which had no difference in yield.

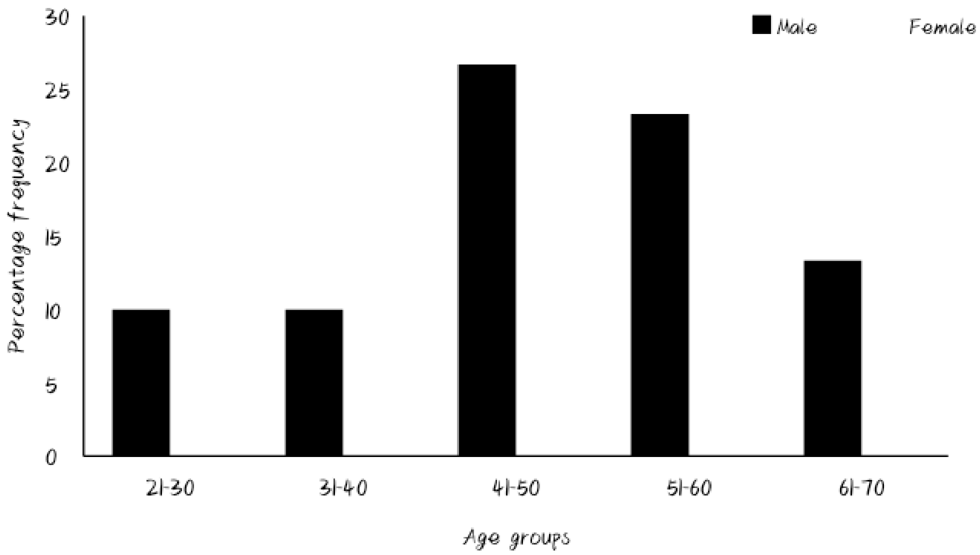


Figure 3: Percentage frequency of age groups of respondents according to gender

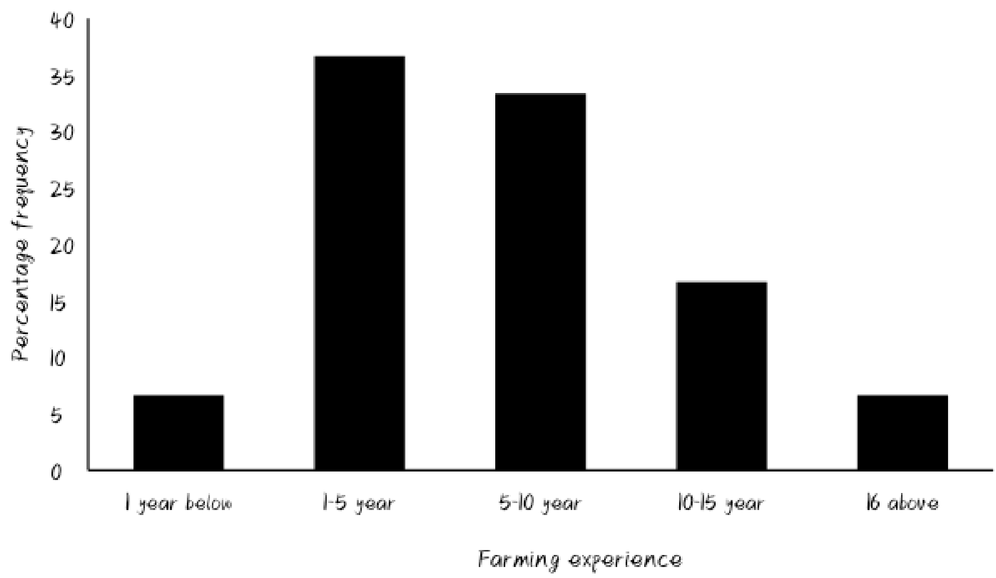


Figure 4: Percentage frequency of farming experience of the respondents

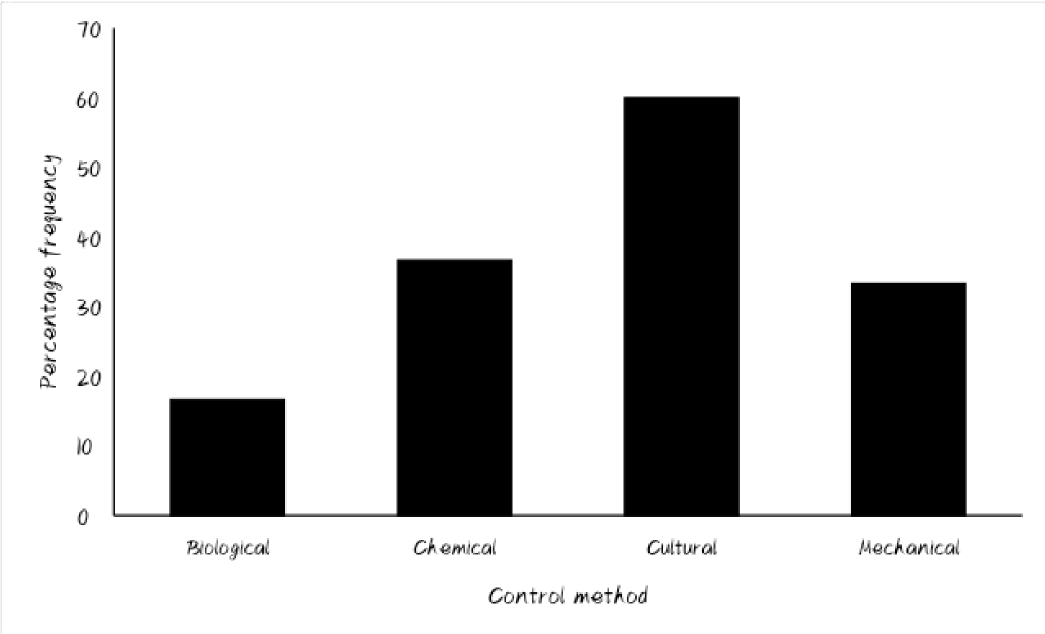


Figure 5: Percentage frequency of insect pest control method employed by respondents

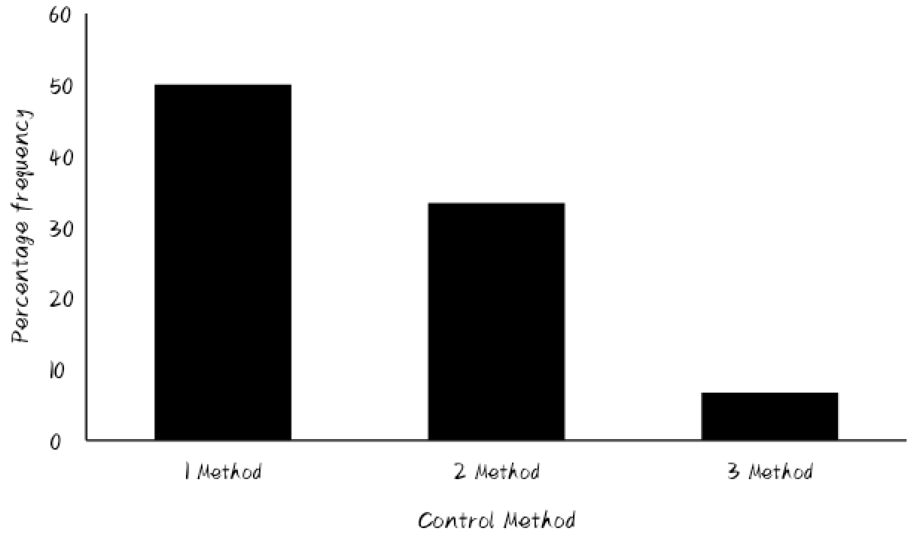


Figure 6: Percentage frequency of number of control methods used by respondents

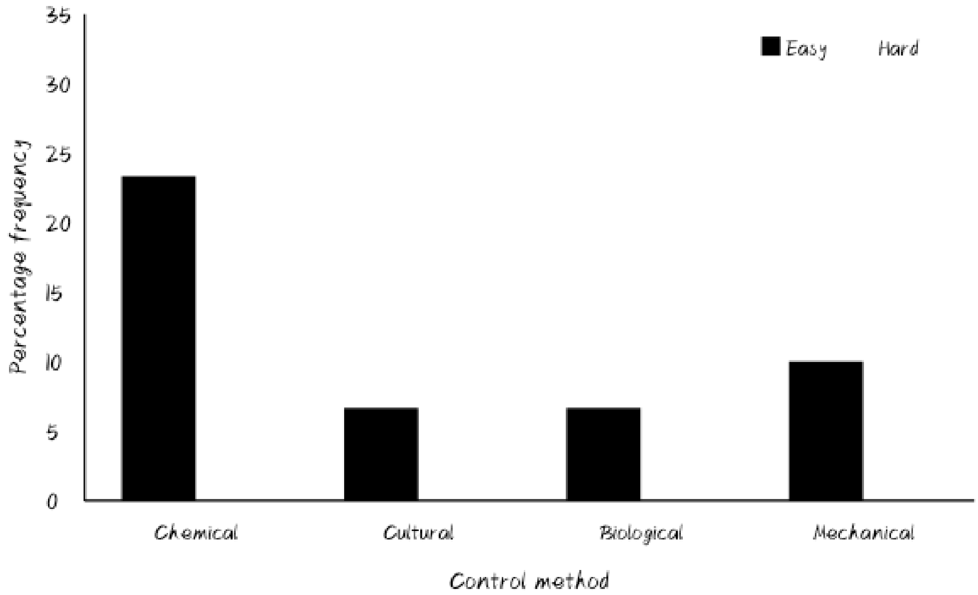


Figure 7: Percentage frequency of the perception of implementation of control methods by respondents

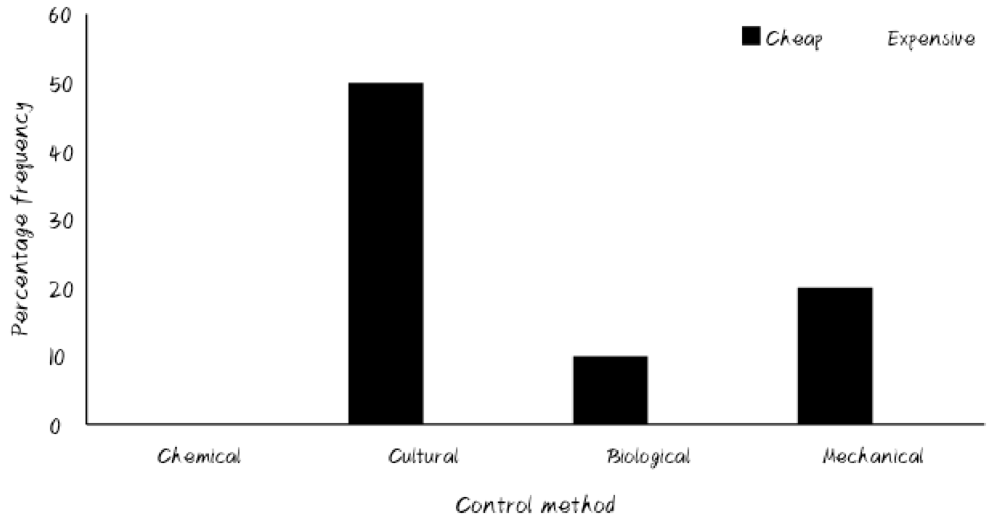


Figure 8: Percentage frequency of the perception of cost of control methods used by farmers

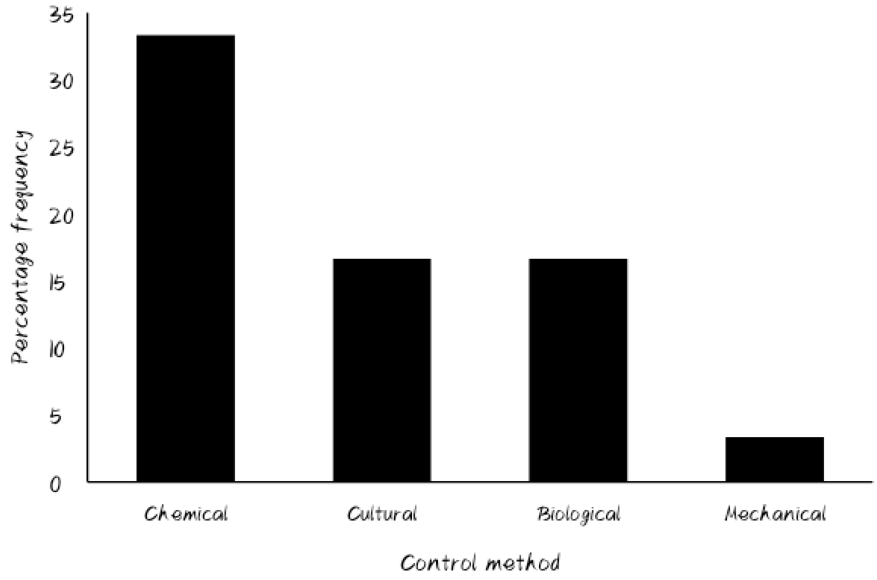


Figure 9: Percentage frequency of effectiveness of the control methods used by the farmers

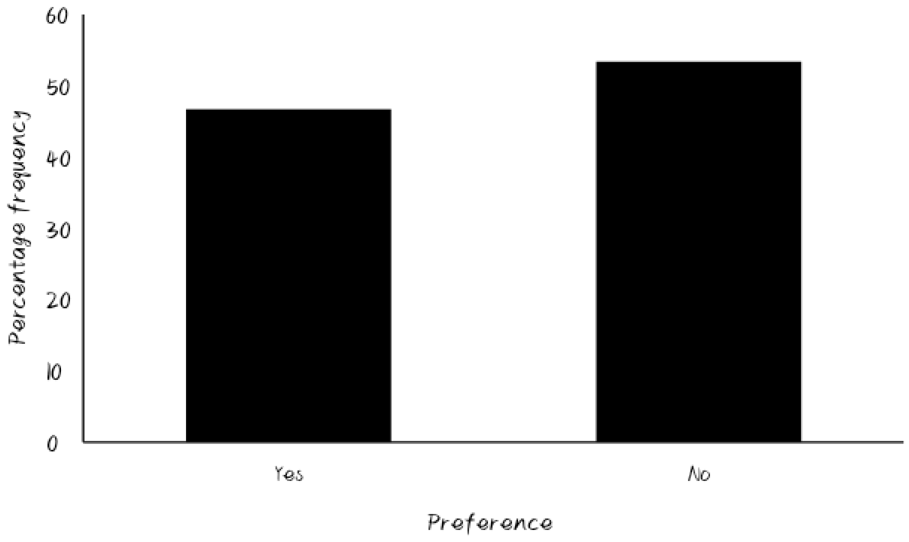
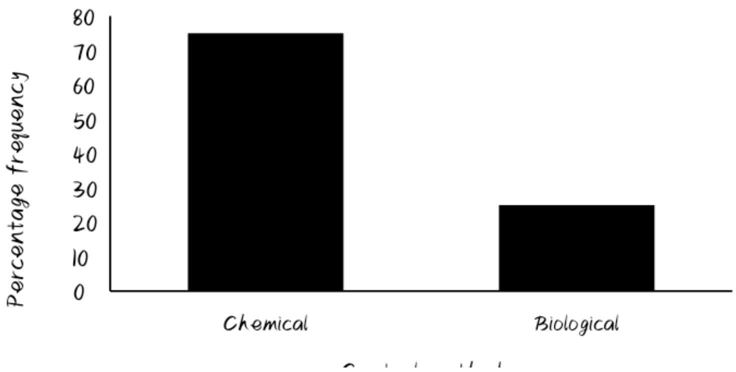
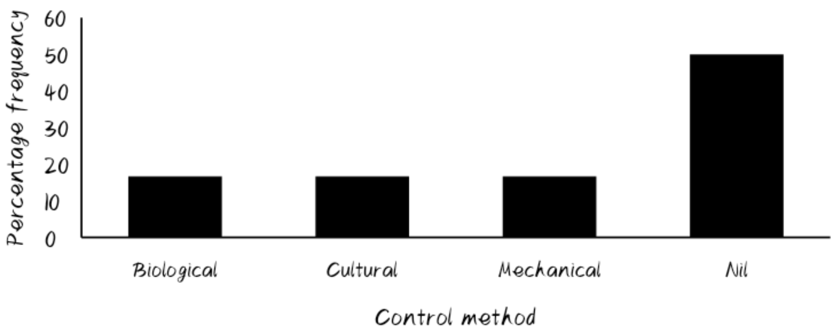


Figure 10: Percentage frequency of respondent’s preference for biopesticide

(a)



(b)



(c)

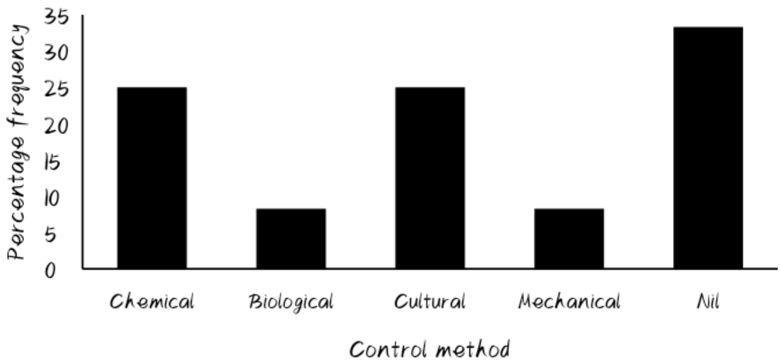


Figure 11: Control methods preferred by the respondents according to farm size (a) large (b) small and (c) average

Table 1: Control methods employed by the respondents

Control method	Percentage frequency
Biological control	3.333333
Chemical control	16.66667
Cultural control	20
Mechanical control	10
Biological and mechanical control	3.333333
Chemical and cultural control	10
Chemical and mechanical control	6.666667
Cultural and biological control	3.333333
Cultural and mechanical control	10
Chemical, cultural and biological control	3.333333
Mechanical, cultural and biological control	3.333333
Nil	10

Table 2: Chemical control methods employed by the respondents

Chemicals control	Frequency of use	Percentage frequency (%)
Abamectin	6 times in a year	3.33
	Once in a year	3.33
Atrazine	4 times in a year	3.33
	Twice in a year	3.33
Chlorpyrifos (ii)	3 times in a year	3.33
	6 times in a year	3.33
Cypermetrin (ii)	3 times in a year	3.33
Glyphosphate (iii)	3 times in a year	3.33
Malathion (iii)	4 times in a year	3.33
Spinosad	Twice in a year	3.33

Table 3: Biological control methods employed by the respondents

Biological control	Frequency of use	Percentage frequency (%)
Biopesticides	Twice in a year	3.33
	4 times in a year	6.67
Toads	3 times in a year	3.33
Neem oil	Twice in a year	3.33

Table 4: Cultural control methods employed by the respondents

Cultural control used	Frequency of use	Percentage frequency (%)
Crop rotation	Every 3 years	3.33
Crop rotation	Every 5 years	3.33
Early harvesting	Every 4 years	3.33
Early planting	Yearly	3.33
Mixed cropping	Every 2 years	3.33
Mixed cropping	Yearly	6.67
Planting disease-resistant crops	Every planting season	6.67
Sanitation	Bimonthly	3.33
Sanitation	Biweekly	6.67
Sanitation	Monthly	10
Sanitation, crop rotation	Monthly, every 3 years	3.33
Sanitation, early harvesting	Monthly, every planting season	3.33

Table 5: Mechanical control methods employed by the respondents

Mechanical control	Frequency	Percentage frequency
Barricades	Always	10
Barricades	Regularly	3.33
Hand-picking, crushing	Often	3.33
Nets	Rarely	3.33
Traps	Often	3.33
	Rarely	6.67
Traps, hand-picking	Often	3.33

Table 6: Respondents preferred control methods and their impact on yield

Control preference	Specific examples of control methods	Yield
Biological	Bacillus thuringiensis (B.t) to kill caterpillars	Increase
Biological	Frogs to feed on grasshoppers and flies	Increase
Biological	Neem on army worm	Increase
Biological	Bacillus thuringiensis (B.t) on maize stem borers	Increase
Biological	Bacillus thuringiensis (B.t) on tomato fruit worm	Increase
Chemical	Abamecti on cassava green mite	Increase
Chemical	Chlorpyrifos on cowpea aphids	Increase
Chemical	Cypermethrin on maize stem borers	Increase
Chemical	Spinosad on tomato fruit worm	Increase
Cultural	Early harvesting to prevent tomato fruit worm	Increase
Cultural	Planting maize/groundnut	Increase
Cultural	Planting maize/beans	Decrease

Cultural	Planting yam, beans, maize	No difference
Mechanical	Weeding	No difference
Mechanical	Weeding	No difference
Mechanical	Weeding	Some increase
Mechanical	Weeding	Increase
Mechanical	Mechanical barrier	No difference
Mechanical	Mechanical barrier to prevent termites	Increase
Mechanical	Physical barrier to prevent termites	No difference

CHAPTER FIVE

5.0 DISCUSSION

The perception of insect pests management methods in rural areas of Badagry LGA can vary widely among the local communities. It's important to consider that perception is influenced by cultural, socioeconomic, and environmental factors. However, some common perceptions and management methods in such areas might include

i. Traditional Methods: Many rural communities in Badagry, Lagos, may rely on traditional pest management methods such as using natural predators, traps, and cultural practices passed down through generations. Examples include:
- Applying extracts from plants such as neem, aloe, jatropha, and spider lily to repel pests and disease (Anegbe, 2005).
- Avoiding the use of synthetic insecticides to prevent environmental and health risks (Namayanja, 2017).

ii. Economic Factors: The cost of pest management methods can influence perception. Some farmers may perceive certain methods as too expensive and opt for cheaper alternatives (Mapfumo *et al.,* 2013).

iii. Indigenous Knowledge: Indigenous communities often have their own knowledge and practices for managing pests that are deeply rooted in their culture and environment. Examples include:
- Using manual methods such as hand-picking and weeding to control pests.
- Using cultural practices such as early planting and crop rotation to discourage pests (Agwu *et al.,* 2017)

This study reveals the different insect pest management strategies used and the various preferences of farmers inhabiting villages in Badagry Local Government Area, Lagos State, Nigeria. The demographic results gotten from the total respondents that responded to our questionnaire in the study area, showed that of the total respondents who were interviewed, 83.33% were males and 16.67% were females out of which 10% were males were between 21-30 years, 10% were males were between 31-40 years, 6.67% were females and 26.67% were males were between 41-50 years, 10% were females and 23.33% were males between 51-60 years and 13.33% were males between 61-70 years. Basically, all respondents knew what insect pests were and could identify them.
Identification of insects by the respondents was easy. The indigenes of Badagry Local Government Area refer to most insect pests as "Kòkòrò". "Kòkòrò" is a generalised term for insects, grub and worms. More specifically, the indigenous referred to the butterfly as

"labalábá" and the caterpillar was called "Ìdin labalábá". This demonstrated a basic knowledge of identification of insect pests.

The study revealed that 36.67% reported using chemical control, 16.67% reported using biological control, 33.33% reported using mechanical control and 60% reported using cultural control methods, which makes cultural pest control methods the most prevalent control methods in villages in Badagry Local Government Area, Lagos State. Although, 33.33% of respondents said cultural pest control methods was the hardest to implement due to the intense physical effort accompanied with it, especially by subsistence farming that get little or no help in running their farms for food proiduction, but it seems that the farmers in Badagry LGA believe in the hard work of farmland sanitation, implementation of specific planting and harvest times and planting of trap crops to draw pest away from main crops, reducing crop damage.

Based on effectiveness, it was voted by 33.33% of the respondents that the use chemicals in pest management was the most effective control methods. While chemical methods are effective in certain situations, they should be used judiciously and responsibly to minimize potential environmental and health risks (Smith, 2020). Some farmers did believe that the chemicals used to repel and reduce insect pests can persist in the environment for lengthy periods of time leading to adverse effects, and also, frequent use of these chemicals could cause the reduction in effects of the chemicals' intended purpose.

It should be noted that respondents that preferred biological and chemical insect pest control measures reached higher levels of education, when in comparison with respondents that preferred cultural, physical and mechanical methods. This is obviously influenced by access to valuable information regarding insect pest management.

Regarding the size of farms, respondents with large farms said they used chemical control (75%) and biological control (25%) (Figure 7). Respondents with small farms said they used mechanical control (16.7%), biological control (16.7%), cultural control (16.7%) and 50% of respondents with small farms don’t use any form of control (Figure 9b). In general, overall crop yield increased for respondents using a form of insect pest control method, specifically, chemical, biological and cultural methods.

CONCLUSION AND RECOMMENDATIONS

The study further buttressed that insect pests have strong economic importance on majorly agriculture and food production, and revealed the various insect pest management methods employed by farmers inhabiting villages in Badagry, Local Government Area, Lagos State. With every pest control method having its limitations, it is recommended that farmers living in rural areas should be educated and enlightened of the strategies of Integrated Pest Management (IPM), which combines more than just one control methods, leading to reduced chemical use, sustainable farmland management practices.

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