DETERMINANTS OF ADOPTION TO CRICKET FARMING FOR IMPROVED FOOD SECURITY IN KENYA

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DECLARATION AND RECOMMENDATION

Declaration

This thesis is my original work and has not been presented for an award of a diploma or conferment of degree in any other university or institution.

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DEDICATION

This thesis is dedicated to my family members for their love and encouragement during the entire study period, more so to my lecturers being the sources of inspiration for this course.

ABSTRACT

The dynamics of weather variation have overstretched animal protein from already overburdened environment; food and feed demand are expected to rise to 3 billion tonnes, with undernourishment projected to 637 million people by 2030. This is likely to increase malnutrition against population, which is projected at 9.7 billion people by 2050. In Lake Victoria Basin, malnutrition has affected children and elderly; cricket is environmentally friendly and has potential of solving the malnutrition problem being faced. Despite the health and economic benefits of cricket farming introduced five years ago, adoption of cricket farming as alternative source of protein is still low among smallholder farmers. The main objective of the study was to assess determinants of adoption to cricket farming for improved food security among smallholder farmers in Lake Victoria Basin. The specific objectives of the study was: to identify determinants of adoption to cricket farming as an agricultural enterprise, assess the adoption rate among smallholder farmers; analyze selected determinants of cricket consumption acceptance level; investigate contributions of cricket farming to household's food security. Mixed methods design was used to collect quantitative and qualitative data from 120 trained cricket farmers from Siaya, Kisumu and Homa Bay. Descriptive statistics and logistic regression models was used to summarize quantitative data while content analysis was used to analyze qualitative data by thematic arrangements and similarities across different investigation areas. Based on data analyzed, the results indicated that socio-economic factors such as gender, age, education, household head, marital status, religious affiliation, family size and farm enterprise income had no association with adoption of cricket farming at p-value ($p>0.05$). Further finding showed that awareness to cricket consumption as food and feed had no association with adoption of cricket farming at ($p>0.05$). Other determinants such as cricket being source of nutrition, food and employment did not show any significant association with adoption of cricket farming at (0.249, 0.848 and 0.247) which were greater than p-value ($p>0.05$). Part of income from cricket, cultural values, perception and attitude were found to be statistically significant to adoption of cricket farming at p-value *(*0.000, 0.020 and 0.041 <0.05). The study concluded that part of income from cricket, cultural values, perception and attitude influence adoption of cricket farming and should be given a major focus if adoption of cricket farming is to be enhanced for improve food security. For the cricket farming to be fully adopted by farmers as alternative source of protein, the study recommends that the government to formulate a policy on farming of edible insects with clear package on extension service to cricket farmers.

TABLE OF CONTENTS

LIST OF TABLE

LIST OF FIGURES

ACRONYMS AND ABBREVIATIONS

ASALs	**:**	Arid and Semi-Arid Lands
ASCU	**:**	Agricultural Sector and Coordination Unit
CAO	**:**	Codex Alimentarius Commission
CDALF	**:**	County Director of Agriculture Livestock and Fisheries
FAO	**:**	Food and Agriculture Organization
FGDs	**:**	Focus Group Discussion
FNSP	**:**	Kenya Food Security Policy
G. H.C	**:**	Government of Homa Bay County
G. K. C	**:**	Government of Kisumu County
GOK	**:**	Government of Kenya
IPCC	**:**	Intergovernmental Panel on Climate Change
ISO	**:**	International Organization Standards
JOOUST	**:**	Jaramogi Oginga Odinga University of Science and Technology
KALRO	**:**	Kenya Agricultural Livestock Research Organization
KEBS	**:**	Kenya Bureau of Standards
KEPHIS	**:**	Kenya Plant Health Inspectorate Organization
KIIs	**:**	Key Informant Interviews
KNBS	**:**	Kenya National Bureau of Statistics
KPHC	**:**	Kenya Population and Housing Census
LCA	**:**	Life Cycle Assessment
MoALF	**:**	Ministry of Agriculture Livestock Fisheries
NGO	**:**	Non-Governmental Organization
OECD	**:**	Organization for Economic Co-operation and Development
SCAO	**:**	Sub-County Agricultural Officers
SDG	**:**	Sustainable Development Goals
SDG	**:**	Sustainable Development Goals
SIIs	**:**	Structured Individual Interviews
UNEP	**:**	United Nations Environment Programme
UNICEF	**:**	United Nations International Children's Emergency Fund
WTO	**:**	World Trade Organization

CHAPTER ONE
INTRODUCTION

1.1 Background Information

This chapter presents the background of the study under thematic sub-sections in line with the research objectives. The thematic subsections include problem of the statement, overall objective, research questions, significance of the study, scope, limitation, delimitation, assumptions and definitions of terms as used in the report.

Since the beginning of known civilization, insects have been a part of a regular diet in many parts of the world and over 2,000 species are considered edible. In most cases, the reason for insect eating is not poverty, but taste (DeFoliart, 1999): People consume insects as a delicacy. The few insect species that are simple to domesticate and cultivate in large numbers have received even more focus. The Gryllidae (cricket) family includes some of these species. Insects used as food for humans and as animal feed are growing in popularity because of their potential to alleviate some of the most pressing environmental concerns. The ability of insects to consume a variety of feed sources and their high feed conversion efficiency are the primary causes of this (van Huis et al., 2013; Halloran et al., 2014).

Cricket farming is one of those rare agricultural industries that has developed rapidly and largely independently of government and research institutional support. This has left monitoring and extension bodies scrambling to catch up, especially as edible insect farming increasingly expands to supply international markets that demand food safety assurances and sustainable practices (FAO, 2020). In response to increasing climatic change, agriculture is under pressure worldwide to produce food and feed on limited land resources. By 2050, the world's population is expected to have steadily increased to 9.7 billion, necessitating increased food and feed production from existing agro-ecosystems (FAO, 2017). According to the Kenyan Economic Review of Agriculture of 2007, 51.0% of the population lacked access to food (Kiome, 2009). In 2008, CBS found a connection between food inaccessibility in Kenya and country's 46.0% poverty rate.

As stated in a report by the FAO, malnutrition is a global health emergency that has a triple burden in developing countries, including undernutrition, micronutrient deficiencies, overweight, and obesity. Thus, according van Huis (2013), addressing this issue would necessarily require embracing more environmentally friendly and sustainable foods, such as edible insects. This was in line with Hanboonsong et al. (2013) observation that, despite knowledge gaps surrounding sustainable wild collection and optimum farming management practices, ingestion of insects like crickets has not been a common source of food in Africa. She presented the argument that raising edible insects had the potential to provide a protein source for the world's expanding population, especially in sub-Saharan Africa.

According to a study by Halloran et al. (2017), *Acheta domesticus*, an omnivorous insect that is global, can be raised as a substitute for other sources of protein. She argued that cricket farming has evolved into a substantial animal husbandry technique and has become the primary source of revenue for farmers in several developed countries. This was in concurrence with (Hanboonsong et al., 2013), whose report indicated that worldwide, approximately 20 000 farms are operating 217 529 rearing pens producing from 1996-2011 on average 7 500 tonnes annually. Koech et al. (2017) further suggested that farming crickets can be done even in drought-stricken areas because it uses little space and little water.

Although cricket farming is still under pilot stage in most parts of the world (Halloran et al., 2016), in Thailand cricket enterprise play a significant social role among rural communities (Halloran et al., 2017). Similar finding has been observed in Cambodia where cricket farming has scaled up from small to medium farms since its introduction in 2010 (Miech, 2018). In Botswana Mopane worms are readily available and is one of the sources of animal protein (Moreki et al., 2012). In Kenya insects such as winged termites, grasshoppers, locusts and crickets has played a major role in providing food and income to communities within Lake Victoria Basin (Ayieko et al., 2010; Halloran et al. 2017). Cricket has potential and can be used to reduce food insecurity and malnutrition among children and elderly person (Van Huis et al., 2015).

Edible insects' consumption in Kenya is constrained by sustainable supply, as communities have to wait for rainy seasons to do wild harvesting, which in turn has affected their farming for improved food security. Although cricket farming was introduced in Kabondo and Bondo sub-counties by JOOUST to improve household food resources, income from the enterprise has remained at infancy stage despite several trainings conducted to farmers. The study therefore sought to examine determinants influencing adoption of cricket farming as alternative source for improving food security among smallholder farmers within Kenya riparian communities in Lake Victoria Basin.

1.2 Statement of the Problem

According to the FAO's (2017) estimate, the world population is projected to reach 9.7 billion people by 2050, and there will be an increase in food and feed demand of 3 billion tonnes due to the already pressured environment. ASCU (2011), report indicated that over 10 million people in Kenya suffer from chronic food insecurity and poor nutrition, with additional 7.5 million people living in extreme poverty. ASCU report further indicated that 4 million people require emergency food assistance while approximately 30% of children were classified as undernourished.

A study by (Halloran et al. 2017), identified cricket farming and consumption as one way of decreasing malnutrition problem among children in Kenya. This was in concurrent with Raheem et al. (2019a) study, which reported that insect rearing could be one method of addressing food shortage and malnutrition. This is because of its high content (Rumpold & Schlüter, 2015) and micronutrients such as iron, zinc and manganese (Ayieko et al., 2016a). Koech et al. (2017) study further recommended inclusion of cricket in biofortification of children food. Cricket farming require a small space, low investment and short maturity cycle. Edible insects such as cricket has potential to provide source of income to households (FAO, 2013), particularly to women and children who harvest hence could cushion them from food insecurity. Koech et al. (2017) in her study observed that high protein content in cricket could be used to supplement food for children as a way of reducing malnutrition, and further argued that rearing cricket requires simple materials and has proved to be economical in terms of water and feed consumption.

Despite their high protein content of 65.04% and economic benefits (Deroy et al, 2015), the commercialization of cricket enterprise has not materialized among the smallholder farmers as its farming is still largely unconventional with more being harvested from the wild. Since the introduction of cricket farming to farmers in Siaya, Kisumu and Homa Bay counties by Jaramogi Oginga Odinga University of Science and Technology 5 years ago, its adoption has relatively remained low amongst smallholder farmers. Further study is recommended to ascertain variables influencing farmers' adoption of the new technology. Studies have been done on issues such as acceptability of biscuits containing 10% cricket (*Acheta domesticus*) compared to milk biscuits among 5-10-year-old Kenyan school children by (Homann et al., 2017), Consumer Acceptance of Edible Insects for Non-Meat Protein in Western Kenya by (Pambo et al., 2016a) among others. Empirical evidence indicated that limited study had been done to investigate the relationship between cricket farming and adoption. The study therefore sought to identify determinants of cricket farming adoption in selected riparian communities in the Kenyan Lake Victoria Basin.

1.3 Objective of the Study

The overall objective of the study was to assess the determinants of adoption to cricket farming for improved food security among riparian communities in the Lake Victoria Basin.

1.3.1 Specific Objectives

The specific objectives included:

i. Identify socio-economic determinants of cricket farming adoption as an agricultural enterprise among smallholder farmers in the Lake Victoria Basin.
ii. Analyze selected determinants for cricket consumption acceptance level as an alternative source of protein among smallholder farmers in the Lake Victoria Basin.
iii. Investigate contributions of cricket farming to households' food security among smallholder farmers in the Lake Victoria Basin.

1.4 Research Questions

The purpose of this study was to answer the following research question;

i. Which socio-economic factors influence cricket farming adoption among smallholder

farmers?

ii. How has the acceptance level of cricket consumption determined its adoption for farming as an alternative source of protein among smallholder farmers?

iii. Which contributions has cricket farming made to household food security among smallholder farmers?

1.5 Significance of the Study

This study was to have the following importance;

The findings from the study was to facilitate the identification of factors, which contributes to low adoption among smallholders' farmers for consideration by policy makers and other development agencies. The study was also to help in developing strategies of enhancing cricket farming among households, which are likely to face high malnutrition resulting from prolonged period of food insecurity. In addition the findings was to contribute new knowledge that will be useful for planning and decision making on future food and feed production strategies by farmers. It was also anticipated that the findings from the study was to identify any need for further research but identify gap on extension service provision and training manual and curriculum for use in different actors in learning institutions.

1.6 Scope of the Study

The study focused on determinants influencing adoption of cricket farming, its acceptance level for consumption and its contributions to households' food security. The study covered Siaya, Kisumu and Homa Bay Counties within the Lake Victoria Basin, Kenya. The three counties were selected based on cricket farming activities previously carried out by Jaramogi Oginga Odinga University of Science and Technology in collaboration with Anglican Development Services (ADS), where smallholder farmers were trained and introduced to cricket farming as a source of food and income. The study targeted cricket farmers who had been trained on cricket farming by JOOUST and ADS, and extension service officers from the government and development agencies from the selected counties.

1.7 Limitations of the Study

The study was limited by geographical coverage; due to the wider area, selected, logistic resources were constrained in terms of timelines and funds to reach sampled farmers

from all corners of the selected counties where cricket was being farmed, and more so to replace those who declined to participate after re-mapping. The study was also limited to mixed methods research design that involved collection of quantitative and qualitative data through administration of digitized questionnaires using Kobo-Collect thus limited the amount of information collected especially from those respondents who were not used to answering digitized questions likewise those respondents who were shy to respond to face-to-face open-ended questions. This was addressed by administering open-ended questions to respondents in their respective groups, which allowed them more time to interact with the researcher. The study encountered limitation of uncooperative respondents whom after mapping and mobilization decline to be interviewed due to their high financial expectation and in this regards new respondents were sampled to replace those who declined, this was addressed by re-sampling new respondents. Other limitation to the study included Covid-19 outbreak, which affected sampling as most of the respondents initially earmarked for the study had reservation and decline to participate for fear of contracting the disease, this consequently limited the evenly distribution of respondents. The study responded to this by ensuring that the researcher adhered to the measures and guidelines of the Ministry of Health i.e. observing social distance, sanitizing and using facemasks during interviews to avoid more infection and subsequent decline by respondents.

1.8Assumptions of the Study

A number of assumptions guided the study, that all the respondents selected for the study were available, willing and ready to provide accurate information as required in the questionnaire. It was also assumed that the farmers selected as respondents had reflection of their practical experiences and challenges concerning cricket farming, while the sample selected for the study was accurate to represent the target population. Other assumptions, which guided the study, was that the instruments developed were appropriate to measure the variables and their relationship to adoption of cricket rearing and the working environment was peaceful and weather conditions favorable to ease the movement and data collect process within the planned time frame.

1.9 Definition of terms as used in the study

Adoption : Adoption is the decision of declining or accepting and subsequently implementing, discontinuing or modifying the technology by an individual or an organization.

Agriculture : Agriculture is the art, science, and business of crop cultivation and livestock rearing for economic objectives.

Assessment : Assessment is the process of determining the rate, extent or amount by which a given variable has contributed to change in practice or achievement of a given objective.

Analyze : Analysis is the process of studying or determining the nature and relationship between the variables under the study.

Cricket : Cricket is a cosmopolitan and omnivorous insect that can be farmed as alternative protein source.

Cultural factors: These are beliefs, values and traditions influence adoption of cricket farming.

Determinants : These factors, conditions or causes makes something happen or leads directly to a decision.

Economic status: This is the farm level of income in relation to the size of land under cultivation, which influence adoption of cricket farming.

Examine : Examine is the process of considering the identification of given variables in detail and subjecting them to analysis in order to discover essential features or make a meaning out of it for final judgment.

Farmers : People whose livelihoods depend to some degree on agriculture and who pursue it primarily with their own and/or their family's labour.

Farming : Is the art and science of growing plants and raising animals for food, other human needs or economic gain.

Food security : Means a situation where all people, at all times have regular and permanent physical and economic access to sufficient, safe and nutritious food to meet their dietary needs and food preferences for an active and healthy life.

Food : Food means any substance consumed to provide nutritional support for an organism. It is usually of plant or animal origin, and contains essential nutrients, such as carbohydrates, fats, proteins, vitamins, or minerals. The substance is ingested by an organism and assimilated by the organism's cells to provide energy, maintain life, or stimulate growth.

Influence : Is a force one person or agent exerts on someone else to induce a change which include changes in behaviors, opinions, attitudes, goals, needs and values or the ability to affect the behavior of others in a particular direction.

Investigate : Is to search out and examine the particulars of in an attempt to learn the facts about something hidden, unique, or complex, especially in an attempt to find a cause.

Malnutrition : Malnutrition is the inadequacy or excess intake of protein, carbohydrates, fat, vitamins and minerals, to meet the daily nutritional requirements of an individual.

Technology : The means and methods of producing goods and services, including methods of organization as well as physical technique. New technology is 'new' to a particular place or group of farmers, or represents a 'new' use of technology that is already in use within a particular place or amongst a group of farmers.

Riparian : Riparian is the bank or the surrounding of a water body i.e. river, lake where people reside of dwell.

Socio-economic Socio-economic is the social standing or class of an individual or a group, which can be measured through their age, gender, education level, income levels as well as their occupation. The socio-economic facilitates the identification of inequities in accessing resources in light of privileges, powers and control.

CHAPTER TWO
LITERATURE REVIEW

2.0 Introduction

This chapter presents the literature review on the study under thematic sub-sections in line with the research objectives. The thematic subsections in the chapter includes cricket as a mini-livestock, adoption of new technologies, cricket farming, Cricket farming in lake Victoria basin, socio-economic determinants of cricket farming adoption, acceptability determinants of cricket consumption which leads to its adoption, contributions of cricket farming to household food security which leads to its adoption, theoretical framework and conceptual framework of the study.

2.1. Cricket as a Mini-Livestock

Crickets are cosmopolitan and omnivorous insect that form part of the mini-livestock and can be farmed as alternative protein source. Crickets belong to the order Orthopnea, family Gryllidae and species *Acheta domesticus*; they have cylindrical bodies, round heads and long antennae (FAO, 2014). FAO report further observed that crickets are popular feeds for pets such as lizards and spiders, which live underneath rocks, tall grasses, leaves, under debris and logs. Crickets are eaten in various parts of world as one of the sources of protein. Crickets were frequently obtained in the past through wild gathering. It is necessary to domesticate these crickets, though, given the growing demand for cricket farming and the necessity for sustainable production. Farming crickets for food is a relatively new concept in Kenya though large-scale production systems are being developed in Thailand. Given that farming of crickets is ecologically, economically and nutritionally beneficial, there is need for a systematic and sustainable production.

2.2. Adoption of new Technologies

According to Mwangi & Kariuki (2015), adoption is the integration of a new technology into routine practice and is followed by a time of experimentation and some degree of adaption. On the other hand, Kee, (2017), define adoption as the decision of accepting or rejecting of a new technology and the subsequent implementation, discontinuance or modification by an individual or an organization. Kee further argued that adoption can be

categorized into different classic segments which include innovators, early adopters, early majority, late majority and laggards. A study by Rogers & Everett, (1983), noted that factors affecting adoption rate of any innovation is its compatibility with the values, beliefs and experiences with the social system.

Farid et al. (2016) emphasized that knowing factors influencing an innovation's adoption is essential to processes of technology creation and dissemination. More so specific factors that influence adoption of improved farming practices among farmers are major gaps that must be bridged if the problem of low technology uptake among farmers is to be addressed. This is consistent with a study by Umar (2016) that revealed that adopting new technologies could increase production and boost farmer revenue. A study by Whitfield, (2013) showed that farmers' decisions about whether and how to adopt new technology are conditioned by the dynamic interactions between characteristics of the technology itself and the array of conditions and circumstances.

2.3 Cricket farming

Cricket farming is a method where crickets are raised for their meat, just as done with poultry or cattle. Cricket farming is a popular activity for farmers in Thailand. Cricket farming play significant social role in rural communities and in turn has strengthened their livelihood diversification strategy Halloran et al. (2017). Early in 2010, Cambodia launched cricket farming, which according to Miech (2018) quickly scaled up to small and medium-sized farms by 2012. A study by Durst & Hanboonsong (2015), noted that insect farming in Thailand expanded rapidly and offered substantial livelihood opportunities for many people who engaged in insect farming, processing, transport and marketing. This was in concurrent with a study by (Raheem et al., 2019a), who noted that insect farms can provide employment opportunities and increased income, especially in lower-income countries. Previous studies by (Verbeke, 2015; Tan et. al., 2015 and van Huis, 2015) in Belgium and Netherlands showed that adoption of insects as a protein source was strongly influenced by motivations towards sustainable food consumption.

In the Sub-Sahara Africa, consumption of edible insect is an ancient tradition. Despite the continent being a home to over 1500 species of insects Raheem, et al., (2018) as cited by

Mariod, (2020), insects such as caterpillars (Lepidoptera), termites (Isoptera), locust, grasshoppers, cricket (Orthoptera), ants, bees (Hymenoptera), bugs (Heteroptera and Homoptera) and beetles (Coleoptra) have been identified and linked to different communities for consumption Saliou and Ekesi, (2017).

In Botswana, insects are a potential sustainable food resource in animal nutrition especially by resource-poor farmers who cannot afford expensive compounded poultry feeds (Moreki et al, (2012). Similar finding was also reported FAO, (2013) which indicated that West Africa consumers like three rhinoceros beetle species which include Oryctus O. monoceros and O. owariensis, which breed in coconut and oil palms; and O. boas, which breeds in rotting vegetation and manure heaps. Further report by FAO indicated that a number of species, such as red palm weevil *(Rynchophorous ferrugineus*), (Cerambycidae, Scarabaeidae and Curculionidae); cicadas (Homoptera); stick insects (Phasmida); termites (Isoptera); mayflies (Ephemeroptera) and wasp larvae (Hymenoptera) are integral part of diet to rural people in the island of New Guinea. Further study by Dele et al., (2018) reported that in Zambia edible insects such as grasshoppers (*Ruspolia differens*) caterpillars (*Gonimbrasia belina* and *Gynanisa maja*) and winged termite (*Macrotermes falciger*) forms part of the diet and are potential to reduce nutritional deficiencies among communities. In the Central African Republic, 96 species of insects are consumed.

In Uganda, Raheem et al. (2018) as cited by Mariod (2020) reported that grasshopper (*Ruspolia nitidula*) and termites (*Macrotermes spp.)* are the most consumed edible insects. Similar findings from (Okia et al., 2017; Odongo et al., 2018) study indicated that grasshopper (*Ruspolia differens*), palm weevil (*Rhynchophorus phoenicis*) larvae and termites (*Macrotermes*) are the commonly consumed by travelers who eat them as snacks while in Rwanda and Burundi, Macrotermes species were the most consumed.

In Kenya, the use of insect for food is an old practice in many communities, currently a more sought-after delicacy in the Western Region of Kenya (Ayieko, 2012 and Koech et al. (2017). Although the practice of insect farming is relatively new as the collection of

edible insects is still from the wild and largely done by women and children. It could be practiced in small space even in drought-stricken areas in Kenya. Drought is the major constraint in Kenyan agriculture resulting to food deficit (Huho and Mugalavai, 2010 and Koech et al., 2017). A study by Hanboonsong et al. (2013) noted that for farmers to realize high production there is a need to develop standard farm management practices for cricket farming from nursery to harvest.

Similar findings reported by Halloran (2016) also indicated that there was a potential benefit of cricket farming in rural communities as long as the barriers to adoption are urgently addressed. According to Ayieko et al. (2016); Halloran et al. (2017), cricket farming is still relatively unknown amongst rural smallholder farmers in Kenya and calls for a need for raising awareness by incorporating cricket farming into the policy as alternative source of protein among farmers.

2.4 Cricket farming in the Lake Victoria basin

Cricket farming is a new practice to most farmers along the Lake Victoria region. Cricket farming in the lake basin started at JOOUST in 2013, whereby only 25 farmers were recruited and trained (Halloran et al., 2016). Since then more farmers have been trained and joined the practice with more than 50 farmers in active cricket farming in different parts of the Lake Victoria region (Ayieko et al., 2016). Ayieko et al. (2016) further noted that the introduction of cricket farming in the Lake Victoria region was successful due to good weather condition which favored insect farming and also the communities were used to eating edible insects such as lake flies, grass hoppers, crickets and winged termites.

2.5 Socio-economic determinants influencing adoption of Cricket farming

Socio-economic profile of farmers plays a significant role in adoption of a particular technology at household level. Study by Durst & Hanboonsong, (2015), identified socio-economic determinants influencing adoption of modern agricultural technologies as age, education level, gender, cost of technology and expected benefits from adoption of the technology. This was in concurrent with (Okunlola, 2011) study, which showed that

socio-economic characteristics of respondents play a significant role in adoption of new technology among the farmers. (Akudugu et al., 2012) classified factors influencing adoption of modern agricultural technologies into economic factors, social factors and institutional factors.

Farmers tend to evaluate new ideas against the benefits they are likely to gain and consequences attached to the innovation in comparison to the existing innovation. A study by Ashraf et al. (2015), found that socio-economic attributes holds strong bonding with awareness and adoption of production practices. This was in agreement with Halloran et al. (2016), study which indicated that cricket farming required much less work than other agricultural activities, thus allowing farmers to give their time to both their families and their other normal agricultural activities. In Thailand small-scale cricket farming had improved the farmers' livelihoods in terms of income they get from cricket sales.

2.5.1 Gender and adoption of Cricket farming

Gender is a significant socio-economic factor, which is crucial for proper operation of agricultural activities and adoption of new technologies at household level (Addison et al., 2018). Women particularly have been found to be slower in adoption of a wide range of new technologies as compared to men (Ragasa, 2012). Gender differences in adoption could be associated to differences in access to information about technological innovations and complementary inputs and services (Ragasa, 2012; Tanellari et al., 2013, Obisesan, 2014 & World Bank, 2017). A study by World Bank (2017), reported that despite women forming larger part of agricultural labor force in parts of Latin America, Sub-Saharan Africa and East Asia, they still have less access to agricultural input and services than men do. On contrary, a study done by Halloran et al. (2016), found that women are more likely to adopt technology such as cricket farming than men. Although Halloran recommended further study to find out what motivated female farmers to adopt more so cricket farming. Tanellari et al. (2013) study revealed that gender was a significant factor in the adoption of new groundnut varieties, with males being more likely to adopt.

2.5.2 Age and adoption of Cricket farming

Age is a major factor influencing adoption of farming technology; young farmers have the skills and knowledge that can easily facilitate understanding of different new farming ideas. A study by (Donkoh et al., 2019), revealed that socio-economic variables such as age of the farmer play significant roles in adoption. Especially young people who are in search for white-collar jobs for high pay resulting to rural urban migration. On the other hand, the elderly lack the energy and motivation to adopt new technologies for income generation even though they may have experience. This was in concurrent with Udimal et al. (2017) study, which found that age and other factors such as farm size, on-farm demonstration and credit access have statistical significance in farmers' adoption of a technology.

Younger farmers are less risk-averse and are always willing to try new technologies as compared to older farmers who have an increase in risk aversion and a decreased interest in long-term investment in the farm Dhraief et al. (2018). This is contrary to what was found by Udimal et al. (2017) which revealed that older farmers had more knowledge, long-term experience and were better placed to evaluate technology information before use than younger farmers did. A study by Opara (2010), reported that social participation, reliance on indigenous knowledge, tenancy status, gender, size of land cultivated, years of farming experience, part- or full-time farming, and age, did not correlate with agricultural information use and subsequent adoption.

2.5.3 Education and adoption of Cricket farming

For any technology to receive high rate of adoption it requires some level of understanding, which can be attained through formal and non-formal education. A study by Fadairo et al. (2015) revealed that there is significant relationship between the years of farming and educational level with farmers' attitude towards the e-wallet. Fadairo argued that educated farmers tend to have higher level of understanding, which helps them to make decision on whether to adopt a technology. A study by Usman (2016) found that education helps in motivating farmers to perceive a given new technology differently but also improve their rate of adoption. This was in concurrent with (Dhraief et al., 2018)

studies, which revealed that educated people are in contact with extension agents hence have positive ability to adopt new agricultural technologies.

Formal education improves individuals understanding and ability not only to take up the technology but also to facilitate its effective implementation. A study by (Melisse, 2018), revealed that household which is headed by highly educated person is more likely to adopt new farming ideas faster than household which is headed with uneducated person. Education helps in enhancing farmers' ability or capacity to receive and analyze information on a given technology. A number of years a farmer has spent in education has positive correlation with the rate of adoption of the technology (Abebe et al., 2013; Halloran et al., 2017). Also it has been shown that education has a positive effect on agricultural productivity (O'Shea et al., 2018), Through the analysis of individual farmers a combination of learning by doing and learning from others, especially ambassador or first mover farmers, appears to enhance human capital accumulation, technical change and increased productivity in cricket farming Halloran et al. (2017).

2.6. Acceptability of Cricket consumption

Despite high protein of 65.04% in cricket Deroy et al. (2015); acceptance to consumption of cricket and capacity to rear them has not translated to food Ayieko et al. (2012); hence remaining a major obstacle to embrace insects as a food resource Payne et al. (2016). Globally, the most commonly consumed insects are beetles (Coleoptera, 31.0%), caterpillars (Lepidoptera, 18.0%) and bees, wasps and ants (Hymenoptera, 14.0%), grasshoppers, locusts and crickets (Orthoptera, 13.0%), cicadas, leafhoppers, plant hoppers, scale insects and true bugs (Hemiptera, 10.0%), termites (Isoptera, 3.0%), drag-onflies (Odonata, 3.0%), flies (Diptera, 2.0%) and other orders (5.0%) (Paridah et al., 2016). However, Ayieko et al. (2016b), contended that although people are gradually accepting to rear and consume crickets at household level, this has not been translated into food security for families. This is in consistence with Looy et al. (2014) findings, which indicated that the acceptance of insects as human food still faces a number of barriers that few other novel foods face. On the other hand, van Huis, (2020), further argued that consumers are becoming conscious of insects as food being viable option of protein source. Motivations to eat insects stem from their cultural and nutritional value,

as well as their numerous environmental benefits. The current pressures on global food security, including climate change, population growth, and shifting dietary preferences, have ignited a search for more environmentally sustainable protein sources.

2.6.1 Cultural beliefs on Cricket consumption

Culture is a way of doing things by people in a particular society. Culture is a major constrain to acceptability and adoption of new farming technology such as cricket farming (Lekhanya, 2013). Culture and religious beliefs heavily influence consumption of insect such as crickets in the world (Cerritos, 2009). According to DaVince, (2004), historically insects are referred to as food in Leviticus chapter 11, verse 22 and in Matthew chapter 3, verse 4. The reference is inconsistence to (Paridah et al., 2016), who argued that people still view entomophagy with disgust and associate insects' consumption as primitive behaviour.

However, Food and Agriculture Organization of the United Nations, (2013) also reported that Food practices are influenced by culture(s), inclined to historically religious beliefs. This is in concurrent with Amato, (2017), study findings which indicated that food acceptance is controlled by affective, personal, cultural, and situational factors, which are based mostly on sensory/pleasure considerations and health. Similar findings have also been reported by Tan et al. (2015) who argued that individual experience takes place within a cultural context where the shared availability of foods and common experiences result in the familiarity and preference towards certain species and preparation methods

This was also corroborated by (Naimi & Mark, 2010) study which showed that cultural resistance to new ideas are fueled by fear, lack of knowledge, religious or beliefs and traditional practices. Naimi and Mark argued that culture shapes people's behaviour to accept or reject a given technology owing to unacceptable practices it is attached. Cultures are tied around practices, which are unacceptable to the society and are termed as abomination or taboos. This may affect a new farming technology such as cricket rearing despite of it being a lucrative enterprise with many benefits to the society. Similar findings were also reported by Halloran et al., (2017) who found that cultural

taboos play a major role in shaping which species of crickets to be eaten by farmers. A study by (Kee, 2017), revealed that for an innovation to diffuse successfully, it should be aligned to cultural norms of a social system. Kee further argued that social values and cultural beliefs, information and ideas presently held by potential adopters influence perceived compatibility. Study by (Pambo et al., 2016b) reported that in Kenya attitudes, subjective norms and behavioural capabilities are considerations in designing food from edible insects (FEI) that are culturally appropriate.

2.6.2. Perceptions and attitudes on consumption

Farmers negative or positive attitude influence their acceptance or rejection of a new technology; this largely depends on how the technology is presented to the farmer. Positive attitude towards selected technologies is an indication of the importance of improved technologies (Ogunsumi, 2011). This is supported by (Li et al., 2020) study, which found that positive attitude toward technology was more likely to motivate farmers to adopt new technologies in practice.

According to Lensvelt & Steenbekkers, (2014) study findings people who have eaten insects before have significantly more positive attitude toward entomophagy than people who have not and are more likely to eat them again thus adopting. The results from (Schösler et al., 2012) study in Netherlands, indicated that consumers had positive attitude to familiar food products processed with insect protein, especially among younger generations. This was corroborated by Wilkinson et al. (2018) study findings in Australia, which revealed that consumers were more willing to accept insects as food if they were incorporated into familiar products, e.g., biscuits, bread, or pasta made from insect-based flour, or as part of cooked meals. House, (2016), argued that consumer attitude toward insect food is influenced by cultural background and the availability of insects and insect-based products in the market.

On the other hand, perception of a farmer on a given new technology is one of the driving forces behind adoption. Farmers tend to evaluate new technologies for their benefits and consequences before they eventually accept it for implementation (Meijer et al, 2015).

The information an individual has about a new technology forms the basis of the perceptions and attitudes, which they develop towards the new technology. The perceived innovation attributes of the technology, is used by farmers to evaluate the perceived relative advantage and benefits of adopting the new technology against the existing technologies. This is supported by Alemu et al. (2017), findings which indicated that, the preferences for different edible insect species is derived by consumer attitude.

2.6.3 Awareness and availability on Cricket consumption

Awareness is the state or ability to perceive, to feel, or to be conscious of events, objects, or sensory patterns (Gafoor, 2012). Technology awareness influence the probability of adoption positively and significantly and enables farmers to know the existence of a technology, its benefits and its usage for them to adopt it (Acheampong et al., 2018). This is in support of (Simtowe et al., 2012), study findings which suggested that adoption could be increased if farmers are exposed to new technology. This is also in concurrent with (Ayieko et al., 2016a), study which indicated that awareness and interest positively embraces insects farming for food and feed among smallholder farmers. Ayieko further noted in her study that awareness creation can be a big milestone especially among smallholder farmers if adoption of cricket farming is to be effectively achieved.

A study by Pambo et al. (2016a) found that having eaten edible insects before increases the probability of accepting edible insects such as cricket. Pambo further argued that many motives, which include convenient with consumer needs, social and environmental responsibility, economic incentives and barriers drive the choice of edible insects for food and as an alternative to conventional meat. This was in consistence with (Lensvelt & Steenbekkers, 2014) study, which suggested that consumer acceptance of entomophagy, can only be increased by consumers themselves with the opportunity to trying insects. For instance, in sub-Saharan Africa (SSA), food production on smallholder farms is critical especially if the regional food security through promoting insect consumption is to be achieved (Frelat et al., 2016). For example, in Central Africa the collection of arboreal foliage consuming caterpillars is facilitated by manipulating distribution of host tree distribution and abundance through shifting cultivation, fire regimes and host tree

preservation; and manually introducing caterpillars to a designated area to trigger availability. In Kenya, cricket farming has not been fully commercialized though consumers are willing to pay for cricket products due to their high nutritional values (Alemu et al., 2017). A study by Hoek et al. (2011) revealed that providing information and increasing awareness alone on the environmental benefits of eating meat substitutes is not likely to be very effective. Price, taste, availability and degree of fit with current eating habits are some of the practical factors associated with the consumption of insect-based product (House, 2016). Further study by Pambo et al. (2016a) revealed that availability of edible insects for food is among the barriers for acceptance of insect consumption.

2.7. Contribution of Cricket farming to household food security

2.7.1 Crickets as sources of income

In Thailand, cricket farming has expanded rapidly and now offers significant income and livelihoods to 50,000 - 75,000 of Thai people (Halloran et al., 2017). Cricket farming presents opportunities for livelihood diversification strategy, which can help buffer rural households against food insecurity and provide an alternative source of income (Halloran et al., 2017). A study by (Durst & Hanboonsong, 2015) indicated that in Thailand, insect farming has expanded rapidly and now offers significant income and livelihood opportunities for tens of thousands of Thai people engaged in insect farming, processing, transport and marketing.

2.7.2 Crickets as food and feed for human and livestock

Worldwide, nearly 1 700 insect species have been used as human food which are rich in protein and can be used as supplements for those humans suffering from poor protein nutrition (Johnson, 2010). Study by Weigel et al. (2018) in Laos found that small quantities of crickets (100g of fresh crickets for women, 75g for children 4-6 years, and 50g for children 1-3 years) can provide sufficient levels of macro and micronutrients. This indicated that cricket farming has potential to improve household diets for both rural and urban households. This is in line with (Raheem et al., 2019a) study findings which noted that in view of malnutrition and (future) food shortage, insect farming may offer a new source of sustainable food.

In Africa, the demand for edible insect especially crickets is growing mainly because animal protein is becoming more expensive and scarcer. The demand for healthier alternatives like insects is growing and has a huge potential in animal feed production. According to a study by Kelemu et al. (2015), use of insects as food and feed has a significant role to play in assuring food security and improving the livelihood of the African people. In Uganda, a variety of insects are being consumed which include termites (*macrotermes spp*.) and grasshoppers (*ruspolia nitidula*) (Raheem et al., 2019). Market surveys done by Raheem revealed that in Uganda wholesale or retail price of some edible insects could exceed traditional animal meat products. For example, market prices of grasshoppers were (40.0%) higher than beef.

In Kenya there is a long and rich history of insect consumption in certain regions of the country. Previous studies conducted revealed consumers with no or little previous exposure to edible insects are resistant to introduce insects such as crickets in their diet (Ayieko et al., 2012). It is anticipated that insect consumption may play a key role as a safety net and gap filling for rural household's food security, thus may be a path out of poverty and sustainable source of protein as compared to other meat products (Yu, 2018). Therefore, farming crickets for food especially in child nutritional interventions may be useful due to its high protein content, which can help reduce child under nutrition Koech et al. (2017).

2.7.3 Employment opportunities

Cricket farming offers a greater employment opportunity through the value chain right from production, processing, distribution and marketing through different retail outlets Halloran, (2017). Halloran further observed that cricket farming creates an enterprise, which needs man power at various value chain supply especially in Lao, and Thailand where farmers are immersed in cricket farming business as employment. Major wholesale markets deal in tons of insects every day, selling to intermediaries who distribute to vendors and restaurants. Halloran further argued that major wholesale buys insects in tonnes and sell small quantities of cooked insects (20 to 30 baht per 100 grams.

According to FAO (2013), insect farming can offer employment and cash income at either small-scale household level or at large industrial production. Similar finding was also reported by (Raheem et al., 2019a), who argued that insect farms can provide employment opportunities and increased income, especially in lower-income countries. Cricket farming has been recognized as an important contribution to rural economy and employment (Halloran et al., 2017). In Thailand, cricket farming has contributed towards developing sufficiency economy through strong community participation and economic independence. Further, there is a rising tendency of, tourists both domestic and international tourists to visit cricket farms.

2.8 Government Policy

A study by Hoppe (2019) defined policy as a plan of action or action of a government. Knill (2009) argued that policy establishment is largely a technical and smooth process by executive and legislature. A study by The House and Road (2021) reported that the main aim of a food policy is to support and strengthening food, health and national security and sustainable agricultural development. Currently there is no policy regulating farming of edible insects such as cricket as a mini-livestock, Hanboonsong, (2013), this is a barrier to commercialization of cricket farming despite the sector having huge potential. A study by Kinyuru, (2017), noted that this as a major setback in promoting cricket farming, despite the increased interest of consumers on edible insects. Similar findings were also observed by Pambo et. al. (2016) who reported that even though consumers feels that insects are available, the existing legal framework does not support meeting the demand due to lack of insect-based food industry. Although the Kenya government in 2017 emphasized the commitment to provide, a framework that promotes food production, self-sustenance and food security this has not covered insects. This was in concurrent with Halloran et, al. (2014) findings which expressed the need to establish a policy that would include insects as feed and food to improve existing national policy

Incorporating insects into a sustainable food system need a better understanding of appropriate and sustainable food policy legislation Halloran (2017). A study by Verbeke et al. (2017) noted that positive atmosphere is essential for adoption of insects; Tanga et

al. (2021) also reported that adoption would only be possible if awareness on social, economic and environmental benefits of insect farming enterprise is made to the public. Establishing policy on insects, farming would not only allow production at farm level but will enhance access to trainings and quality extension service provision by both government extension workers and development agencies for improved and quality production.

2.9 Theoretical and Conceptual Framework

2.9.1 Theoretical Framework

This study was guided by diffusion of innovation theory by Rogers & Everett (1983), which explained how and at what rate new ideas and technology spread. Diffusion is a process by which an innovation is communicated over time among the participants in a social system. Adoption was taken as a decision of full use of an innovation as the best course of action available while rejection was a decision not to adopt an innovation. Diffusion was defined as the process by which an innovation is communicated through certain channels over time among the members of the society. Four components of diffusion of innovation were identified which included innovation, communication channels, time and social system.

It was observed that an innovation may have been invented long time ago, but if individuals perceive it as new, they may still take it as innovation. The newness characteristic is preceded by adoption, which is more related to three steps that include knowledge, persuasion, and decision to adopt the innovation, implementation and confirmation. Details of steps in innovation decision adoption process are as shown in *figure 1* below. According to this theory, farmers trained on cricket farming may decide to adopt or reject the practice of cricket farming depending on how they perceive it.

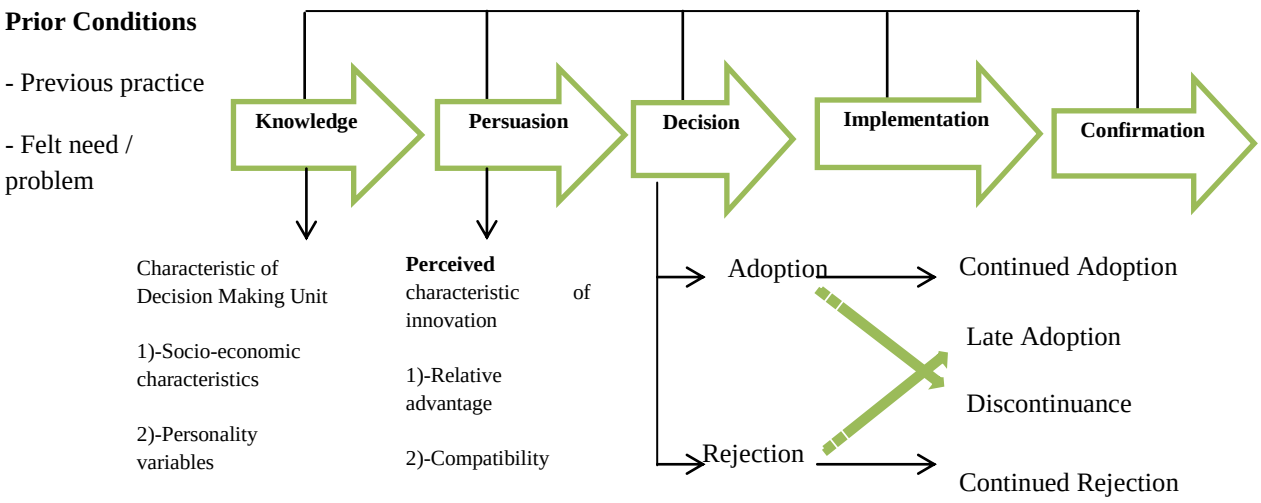

Figure 1: *A model of stages in the innovation decision adoption process*

Source: Rogers and Everett (1983)

According this model adoption can be classified into five categories and in each category; the adopters are similar in their level of innovativeness. These include innovators, early adopters, early majority, late majority and laggards. Innovators are comparable to those cricket farmers who are willing to experience and implement cricket farming irrespective of it being unprofitable. Early adopters are considered as a few cricket farmers who are free to interact with social systems and extension service providers for information or advice and take up cricket farming.

While early majority are the few farmers who adopt cricket farming just before the average member of a social system. They interact frequently with their peers, but seldom hold leadership positions. The unique position between the very early and the relatively late to adopt makes them an important link in the diffusion process. The late majority are few farmers who are always skeptical to farm cricket and its outcomes, though economic necessity and peer pressure may lead them to adopt the innovation. Laggards consist of traditionalist who believes on their way of doing things and are always skeptical to adopt cricket farming. Their social network and system mainly consist of members of the same category and this makes them lack awareness on cricket farming as they want wait and see how their fellow farmers are progressing with the technology. Based on the theory classification of cricket farmers into the five categories of adoption are influenced by

their socio-economic status, their willingness to consume crickets as food or feed as well as the perceived contributions and improvements cricket farming would bring to their food security.

2.9.2. Conceptual framework

Conceptual framework of determining factors influencing adoption of cricket farming was as shown in *Figure 2* below:

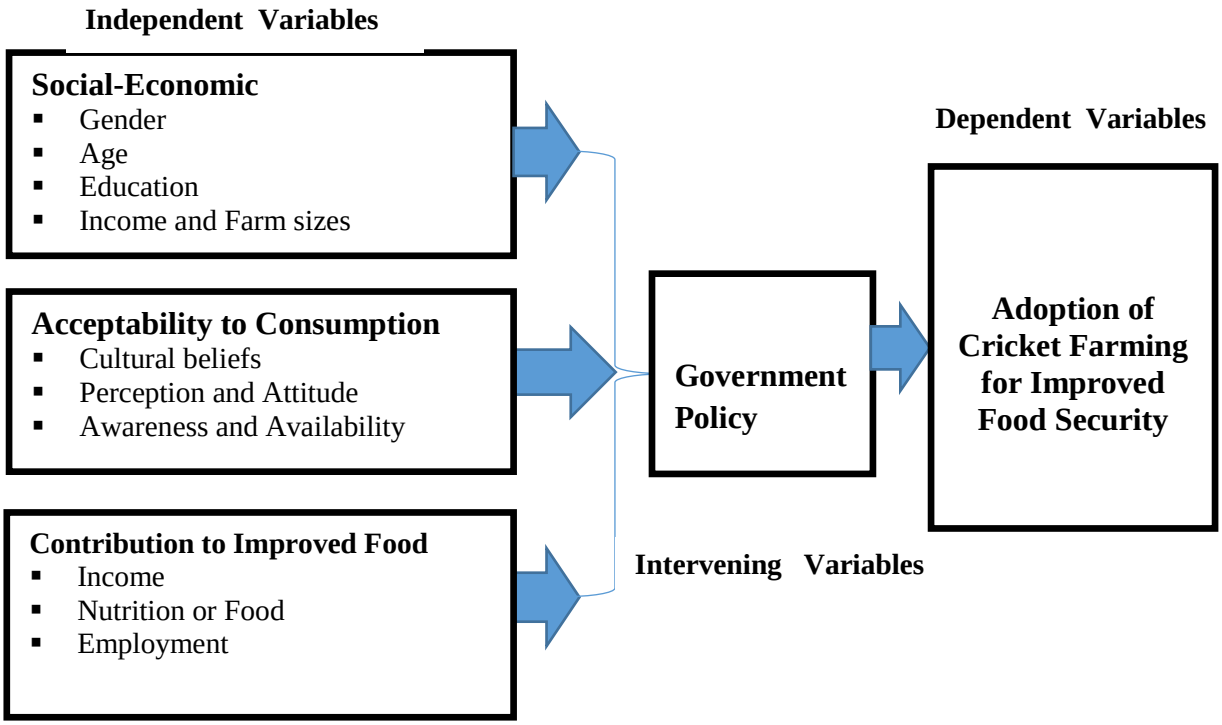

Figure 2: *Conceptual framework of factors influencing adoption of cricket farming*

Source: Study, (2020)

The conceptual model provided a reflection of independent and dependent variable about determinants influencing adoption of cricket farming in Siaya, Kisumu and Homa Bay Counties. The framework presented a relationship between the independent variables and dependent variable in the study area. The conceptualized independent variables under this framework included socio-economic factors, acceptability to consumption and contribution to improve food security.

CHAPTER THREE
METHODOLOGY

3.0 Introduction

This chapter presents the methodology used in this study. Specifically, it provides a brief description of the study area, research design, study population, sampling techniques, sampling procedure and sample size, research instruments, pilot study, validity and reliability of research instruments. It also explores the techniques for data collection, ethical consideration and data analysis procedure.

3.1 Study Area

The study was conducted within the Lake Victoria Basin in selected riparian counties of Siaya, Kisumu and Homa Bay. These counties represented different agro-ecological characteristics as detailed in map of the study area in the annex. The choice for the three counties for the study was based on the previous crickets farming projects that was implemented in cluster wards in Siaya, Kisumu and Homa Bay counties by Jaramogi Oginga Odinga University of Science of Technology and Anglican Development Services. In addition, the three Counties have had previously; a tradition of consuming edible insects such as lake flies, winged termites and cricket hence formed a potential area for studying determinants, which affects adoption of cricket farming despite being in abundance. The study focused on individual counties profile, which included crops, soil type, rainfall, temperature and humidity. This was to help the researcher understanding different periods when production is at peak and how the climate change or changes in weather pattern affects production cycle and ability of farmers to produce continuously irrespective of weather changes as shown in *figure 3 below;*

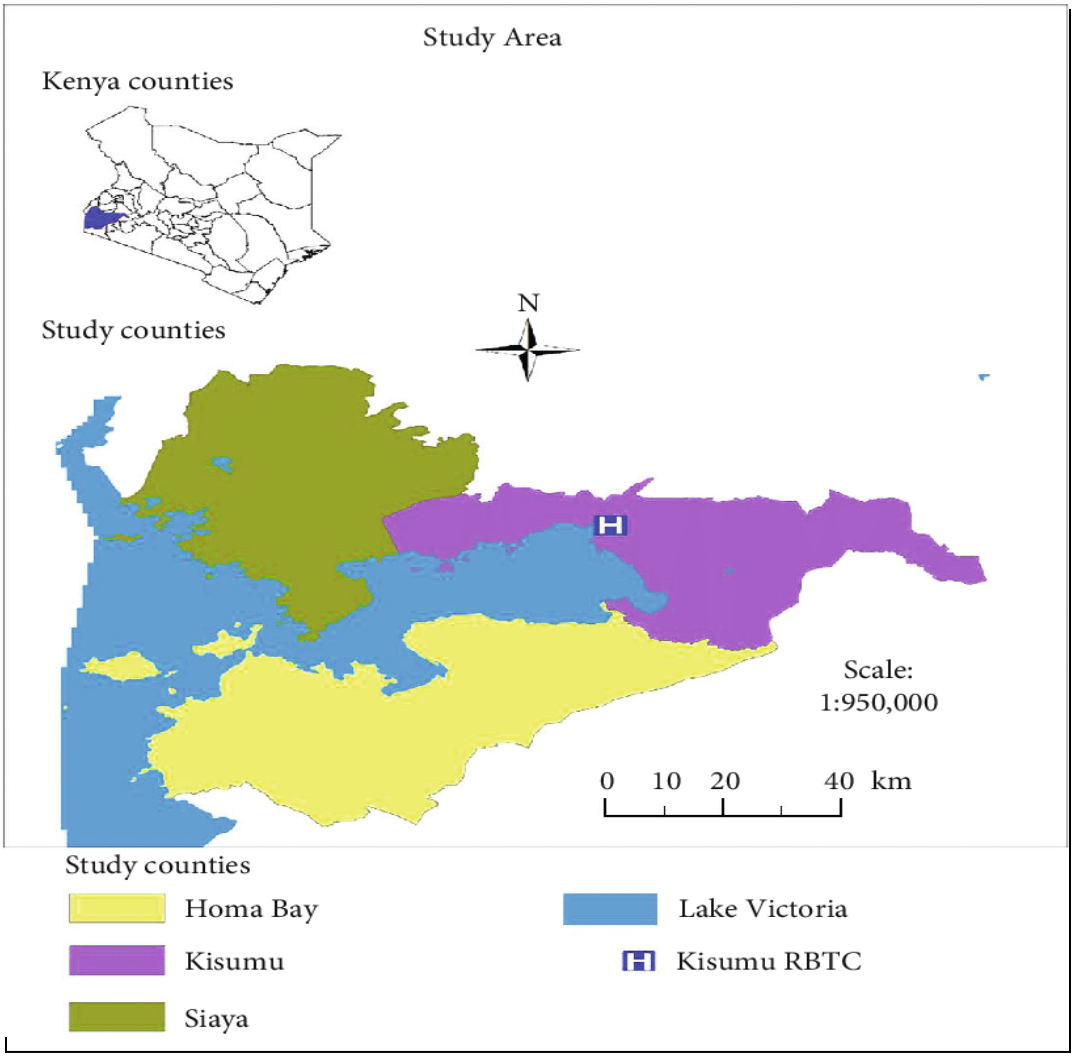

Figure 3: *Map showing the study areas.*

Source: Wikipedia (2020)

Siaya County has a total population of 993,183 people (KNBS, 2019), an annual mean temperature range of 21.8°C–20.9°C, with a total rainfall of 1500–1900 mm. The County has an altitude of 1300-1500 m above the sea level. The predominant soil type is ferralsols with low to moderate fertility unable to produce without the use of organic and inorganic fertilizers. The main food crops grown in the county are maize, sorghum, millet, bean, cowpea, cassava, sweet potato, vegetables and finger millet. While the main cash crops include cotton, sugarcane and ground nuts. The livestock being reared are zebu cattle, dairy cows, dairy goats, poultry, local goats, sheep, pigs, rabbits and bees (MoALF, 2016). The county is characterized by high poverty levels of 47.6% and food insecurity characterized with fewer meals per day intake with limited diversity (KNBS,

2019). The County has 80.7% of households experiencing stunting rate of 24.7% and wasting rate of 0.2% much owing that the food demand does not match the increasing population (MoALF, 2016).

The second area of study was Kisumu, which has an estimated human population of 1,155,574. The County is warm with annual rainfall ranging 1000-1800mm during the long rains and 450-600mm during the short rains. The County is 1,144 meters above the sea level with the main livestock breeds reared being dairy cattle, beef cattle, pigs, goats, sheep, poultry, rabbits and bee keeping. Despite having, suitable ecological and climatic conditions for the production of cotton, sugarcane, rice and horticulture its performance has been dismal. The main food crops being grown are maize, beans, rice, sorghum, green grams, sweet potatoes, cassava tomatoes, cowpeas, kales and groundnuts (County Government of Kisumu, 2018). A study by County Government of Kisumu, (2018) found that the average calorie per person per day was 1727 Kcal for male headed and 1548 Kcal for female headed and youth headed households against the standard level of 2766 Kcal. About 62.0% of female-headed households were found to be food insecure compared to 42.0% male headed.

The third area of study was Homa Bay, which had estimated human population of 1,131,950 with annual rainfall of 700-800 mm and minimum temperatures ranging from 18.6°C to 17.1°C. The county has two rainy seasons namely the long rainy season from March to June (250-1000 mm) and the short rainy season from August to November (700-800 mm). The county has three types of soils: black soils (vertisols– cotton soils), silt loam and clay loam (luvisols). The main crops produced included maize, beans, sorghum, millet, kales, sweet potatoes and peas. While the main livestock kept, are zebu cattle, the red Maasai sheep, the small East African goat and the indigenous chicken (Integrated & Plan, 2017). According Kenya Government Annual Report, (2013), about 82.0% of households in Homa Bay County are food insecure. The food insecurity in the county peaks from July - August and December – March. It was important to understand both temperature and rainfall patterns, temperature was key in determining cricket hatchability period, while rainfall was key in assessing the availability of feeds for

rearing crickets by smallholder famers. This was in line with Orinda et al., (2021) study, which reported how variation of different temperatures affect cricket eggs hatchability.

3.2 Research Design

The study adopted a cross sectional survey using mixed method research design, which involved collection of data using both quantitative and qualitative approaches. Cross sectional study was used for its economic advantage in quantitative data collection. This was also in support to (Sedgwick, 2014) study which revealed that cross sectional studies are quick, easy and cheap to perform as they are often based on questionnaire survey. There is no loss of time in follow-up since respondents are interviewed only once. On the other hand, mixed methods research was found to be appropriate approach for quantitative and qualitative data collection. This was in concurrence with (Creswell & Clark, 2018), who argued that mixed methods research was a combination of qualitative and quantitative research approaches which could be used to provide a broader purpose and in-depth understanding. This was also corroborated by (Stenger et al., 2014), who argued that mixed methods research entails collecting quantitative data using research instrument and qualitative data reports from focus group discussions for triangulation purpose. While (Wisdom & Creswell, 2013), in their study indicated that mixed methods research was an emergent methodology of research that advances the systematic integration of quantitative and qualitative data within a single investigation or sustained program of inquiry.

Quantitative data was collected using questionnaire placed on Kobo-Collect digitized platform software app that was uploaded on android phone for examining determinants for adoption to cricket farming for improving food security. Predetermine guides with open-ended questions was used to collect qualitative data.

3.3 Study Population

The three categories of respondents involved in the study were farmers trained on cricket farming, farmers in active cricket production and extension service providers. A study population of 170 accessible cricket farmers in the Kenyan Lake Victoria Basin within the Siaya, Kisumu and Homa Bay were identified for the study.

3.4 Sampling Procedure and Sample size

3.4.1 Sampling Procedure

Kenya's Victoria Basin is a geographically a diverse region; hence a multistage sampling strategy was used for this study. From 13 Counties in the Kenyan Victoria Basin where cricket farming had been started, three counties, comprising Siaya, Kisumu, and Homa Bay, were selected for the first stage. This was done to narrow down the study to manageable geographical area in terms of logistics and time.

The second stage adopted the stratified sampling technique, wherein each of the chosen counties was divided into strata, with each sub-county constituting a stratum; as a result, three sub-counties where cricket farming was being practiced were chosen from the three counties constituting a stratum. Out of the five sub-counties in Siaya, Bondo was sampled; out of the six sub-counties in Kisumu, Kisumu East; and out of the seven sub-counties in Homa Bay, Kabondo Kasipul. The three sub-counties were selected based on the previous cricket farming activities that was initiated among smallholder farmers by JOOUST and ADS.

The third stage was narrowed down to cricket farmer groups upon which 3 groups were identified from each sub-county from which simple random sampling was done to select households, each cricket farmer had equal chance of being selected for the interviews from the three targeted cricket farmer groups. According to a study by Usman (2016), the requisite sample of respondents for a study can be chosen using both multistage and simple random sampling procedures. This was also found to be in line with (Etikan, 2017), study which reported that multi-stage sampling design is effective where combination of probability methods of sampling is used and can be applied a big inquires

of geographical area. Etikan argued that stratified sampling could be used to divide population into sub-groups that are individually more homogeneous than the total population where the respondents could be selected from each stratum to generate a sample. The respondents for key informant interviews and focus group discussions were purposively sampled. This method was used to a deliberate effort to reach respondents who had information about adoption of cricket farming within the study area. Report by Ames et al. (2019) indicated that purposive sampling could be employed to decrease the number of data to a manageable number. Ames argued that purposive sampling strategy could be used for exclusion of large numbers of data, which can threaten the quality information in a qualitative study. This sampling method was also found to be in line with (Udimal et al., 2017), study which used purposive sampling technique to select the required number of rice farmers for the interview.

3.4.3 Sample size

The determination of sampling frame was informed by a list of 170 farmers who were trained on cricket farming by Jaramogi Oginga Odinga University of Science and Technology and Anglican Development Services (ADS) in Siaya, Kisumu and Homa Bay. The study employed (Cochran, 1977) sample size calculation formula because of its advantage of allowing a sample size to be obtained from known population to arrive at a representative number of respondents as shown below:

$$n = \frac{z^2 Np(1-p)}{(e^2 N)+(z^2 P[1-p])} \quad \ldots\ldots (1)$$

Where:

n = Sample population.

N= Population (170)

Z = 1.96 at 95% confidence level).

P = Population sample proportion to be 0.5 (50%) to provide the maximum sample size.

e = acceptable margin of error of 5% (0.05).

A study by Fadairo et al. (2015) indicated that a representative of 50% is considered good enough especially in cases where study areas share the same agricultural characteristics. A sample of 50%, which was used, based on the number of cricket farmers who had been

trained by Jaramogi Oginga Odinga University of Science and Technology and Anglican Development Services. Sample determination was done using (Cochran, 1977) formula whereby a total of 118 respondents was obtained from a population of 170 people and adjusted to 120 to allow even distribution across the three study areas. For quantitative data household questionnaire, using digitized platform was used to interview 75 respondents who were spread equally across the three counties. While for qualitative data, question guide with predetermine questions was administered to 45 respondents who were sampled from the study area with each county having 15 respondents who were further categorized into three groups per county. This was done to ensure that the study was in strict adherence to covid-19 measures by the Ministry of Health, each focus group discussion had 5 respondents with each county having a total of 3 focus group discussions. This was done about the resources available to conduct the study and the level of accuracy of the result that was required. The sample frame was obtained from each Ward as outlined in *table 1* below.

Table 1: *Distribution of respondents by County*

Counties	**Farmers**		**Total**
	Individual	Group	
Siaya	25	15	40
Kisumu	25	15	40
Homa Bay	25	15	40
Total	75	45	120

Source: Study (2020)

3.5 Research Instruments

The study employed semi- structured questionnaire as the main tool for collecting quantitative data using digitized platform. Qualitative data was collected from focus group discussions and key informants through face-to-face meeting using interview schedule with open-ended questions.

The questionnaires were structured into different sections, which were meant to address specific objectives of the study. The first section of the questionnaire sought to understand the location of the respondent's household and their contact for any call back. The second section of the questionnaires sought to identify the main socio-economic determinants of adoption to cricket farming among the smallholder farmers. The third section had questions, which sought to analyze cricket consumption acceptability level as an alternative source of protein among smallholder farmers. The fourth section had questions which sought to understand the contributions of cricket to household food security i.e. income, nutrition and food as well as employment creation.

3.5.1 Pretesting Study Instruments

Piloting is the testing of questionnaires on small sample of respondents on appropriate basis from the real respondents. The study tools were pre-tested on fifteen farmers who had experience in cricket farming. The respondents were drawn from North Sakwa Ward in Bondo sub-county Siaya, Kolwa Central Ward in Kisumu East sub-county, Kisumu and Kabondo East Ward in Kasipul Kabondo sub-county, Homa Bay counties respectively. This was done to test research protocols, data collection instruments, sample recruitment strategies, and other research techniques in preparation for the actual study.

This was in line with (Perneger et al., 2015), who argued that pre-testing data collection tools verify clarity of the questions to the audience and whether proposed response options are able to provide meaningful answers.

3.5.2 Validity of Research Instruments

A study by (Heale & Twycross, 2015), defined validity as the extent a concept in a quantitative study is measured accurately. This was found to be in concurrence with (Bajpai & Bajpai, 2014) who argued that validity helps to test how well an instrument is developed to measure a particular concept. The study also conducted content, internal, external and statistical validity to ascertain the degree of extent to which variables are measured. This was done at various levels; the first being the standardization and pre-testing of the study tools to make sure the questions were understandable and able to

elicit the same responses when given to various respondents. In order to confirm that the questions in the tools were pertinent and able to capture the desired data that would meet the study objectives, consultation with supervisors and department specialists was also conducted.

3.5.3 Reliability of Research Instrument

Reliability test ensures consistency across time and various items of a research instrument (Mohajan, 2017), further report by (Nawi, Tambi, Samat, & Mustapha. 2020) indicated that reliability test greater than 0.6 shows stronger association for all variables. The study conducted stability, content, internal and external reliability to check consistency of data collection instruments in giving feedback that was able to answer study objectives upon which a correlation of 0.9 was achieved. Final data collection tools were reviewed after pre-testing before being uploaded on the android phones.

3.6 Data collection

Quantitative data collection took a period of five days in each County whereby the digitized questionnaires were administered to cricket farmers in the three sub-counties of the study. Similarly, qualitative data collection took three days with one day spent on focus group discussion with cricket farmer groups and two days for key informant interviews with technical staff from government and development agency. All the qualitative interviews were conducted by the study using structured questionnaire with components examining how various factors such as socio-economic factors, acceptable level of cricket consumption, contributions of cricket farming influence adoption among smallholder farmers.

3.7 Data Analysis

3.7.1 Quantitative Data Analysis

The study employed both quantitative analysis using Hosmer-Lemeshow test to assess goodness of fit of the logistic regression model. For quantitative data, both descriptive and binary logistic regression analysis was done on categorical variables using SPSS software. The first objective of the study sought to establish whether gender (Female=0, Male=1), age and education level necessitating the use of Likert scale had influence on

the adoption of cricket farming. In order to test the research question different variables, which, include gender, age and education level, were introduced in the model.

This was in concurrent with (Mchugh, 2013) who argue that chi-square (X^2) can be used to test relationships between categorical variables, this was used to determine factors that influence adoption of cricket farming.

$X^2 = \sum \frac{(O-E)^2}{E}$ 2

Where:

O = is the observed frequencies

E = is the expected frequencies

Statistical Model and Analysis

According to Tillmanns & Krafft, (2019), a logistic regression models can be used to predict adoption rates based on different independent variables (factors).

This model was found to be suitable for analyzing single categorical variable as illustrated below:

$\log(\frac{p(x)}{1-px}) = \beta_\circ + \beta_1 x1 + \beta_2 x2 + \beta_3 x3 + \beta_1 x1 + \varepsilon i$ *3*

Where:

p = is the probability of success.

x = is value for explanatory variables.

β_0, β_1 =are unknown regression parameters to be estimated.

$\mathcal{E}i$ = is error term from the fluctuation among variables.

Logistic regression model was used to predict adoption rate of cricket farming using different categorical variables. Similar study by (Usman, 2016), also used logistic regression model was found suitable because the dependent variable (Y) was a dichotomous variable which took the value "1" for adoption, and "0" otherwise.

Where; β' represents the vector of parameters associated with the factors x.

The empirical model for the study was specified as:

$Y = \beta_0 + \beta X_1 + \beta X_2 + \beta X_3 + \beta X_4 + \beta X_5 + \beta X_6 + \beta X_7 + \beta X_8 + \beta X_9 + \varepsilon$

Where: Y_i= dummy (1 = adopted; 0 =otherwise)

X_1 = Gender

X_2 = Age (years)

X_3 = Education level

X_4 = Cultural Beliefs

X_5 = Perception and attitude

X_6 = Awareness and availability

X_7 = Income

X_8 = Food and nutrition

X_9 = Employment

For each variable in question inferential statistics (i.e. chi-square and logistic regression) was used to measure the relationship between independent variables *(gender, age, education, cultural beliefs, perception and attitude, awareness and availability, income, food and nutrition as well as employment)* and dependent variable (adoption cricket farming) using SPSS computation programme.

Qualitative data from key informant interviews (KIIs) and focus group discussions (FGDs) were analyzed into themes, which were coded manually based on emerging themes and their similarities across the different investigation areas. This involved comparisons, response convergence and divergence, analysis, and mixed method integration. The information was used to complement the analysis and reporting of quantitative data. This was in concurrent with (Guest et al., 2019), who argued that the overreaching themes and sub-themes of qualitative data can be reviewed, defined and refined through thematic maps to answer the research questions.

3.8 Ethical Considerations

In preparation for the study, various documents and permits were obtained to facilitate smooth collection of information from the respondents. These included Ethical Review approval letter, which was obtained from Jaramogi Oginga Odinga University of Science and Technology Ethical Review Committee. A letter of introduction was obtained from

the University Board of Post-graduate Studies, which allowed the researcher to proceed to the field for data collection. The study also obtained National Council for Science, Technology and Innovation (NACOSTI) permit from the Government of Kenya to ensure that the research which was being undertaken remain with the expected scope of scientific research, technology development and innovation.

Other approval letters obtained included a letter from Kisumu County Chief Officer of Agriculture Livestock and Fisheries, Homa Bay County Directors of Agriculture Livestock and Fisheries and Kisumu Sub-County Agricultural Officers (SCAO). Besides authorization letters, consultation meetings were held with technical staff and local leaders to seek their guidance on downward mapping and subsequent mobilization of cricket farmers in the areas of study. This facilitated grass root planning, understanding of cricket farmers, their distribution, production levels, market volumes and consumption trends, determined logistical concerns and established contacts with the village gatekeepers before formal data collection exercise was rolled out. Further checks and balances were done in the digitized questionnaire with data collection timelines.

Further ethics consideration were done to set moral principles of conduct to govern the decision-making behaviour of an individual. These principles guided the study while dealings with individuals and groups. During data collection the study observed a number of ethical issues which included explaining to the respondents the purpose of the research, sought respondents' consent to participate before starting interview, assuring respondents that their participation is voluntary and they can choose take part or not as well as assuring them total confidentiality to all information they provide during the study. Other principles of research ethics observed included decency, openness and honesty and finally carried out the study responsibly. Four research assistants engaged in the study were taken through the modest training on how to approach respondents and administer questionnaire without violating their rights. The researcher adhered to Ministry of Health protocols on Convid-19, which included physical distancing, hand washing and sanitization, especially when interacting with respondents.

CHAPTER FOUR

PRESENTATION OF RESULTS AND DISCUSSION

4.0 Introduction

This chapter presents the findings and discussions of the study under thematic sub-sections in line with the research objectives. The thematic subsections include socio-economic characteristics of the respondents; acceptability to consumption; contribution of cricket farming to income, nutrition and food, employment creation; strategies of cricket farming.

4.1 Questionnaire Response Rate

The response rate for the study was (100.0%), this was in concurrence with (Fincham, 2008) study which indicated that a response rates of (60.0%) is appropriate for a survey research and should be the goal of the study. The (100.0%) response rate was achieved due to proper mobilization and mapping of cricket farmers in their respective Wards as well as good planning of data collection process, which increased efficiency and effectiveness in reaching out to respondents and collecting data. In some cases, call backs were made for sampled respondents who could not be found in their homesteads and in the event of an unsuccessful call back, the respondent were substituted with the next immediate cricket farmer.

A total of 120 respondents out of which 75 respondents were targeted through digitized questionnaire while 45 respondents were targeted through focus group discussions. However, during quantitative analysis only 75 respondents were used while 45 qualitative data drawn from focus group discussions and key informants was analyzed and used to compliment quantitative findings. The analysis from households' interviews indicated that the 18 female and 7 male respondents were from Siaya as compared to Homa Bay County which had relatively a smaller number of 5 female and 20 male respondents. From Kisumu County, the respondents comprised of 13 females and 12 males.

4.2. Socio-economic Profile of the respondents

4.2.1 Gender distribution by County

Majority of the respondents in Homa Bay County were males at (26.0%) of respondents as compared to females who comprised a minority of (6.7%) of respondents. In Siaya County, females comprised the majority (24.0%) of respondents while males constituted (9.3%) of the study sample. This was found to be different in Kisumu County where females and males were at (17.3%) and (16.0%) of the respondents respectively. The overall findings from the three counties showed that the majority of cricket farmers were male at (52.0%) of the respondents as compared to female who had (48.0%) of the respondents, this variation could have been attributed to high income, men were anticipating from cricket farming (Table 2).

Table 2: *Gender distribution by County.*

			County			
	Variables		Siaya	Kisumu	Homa Bay	Total
Gender	Female	*n*	*18*	*13*	*5*	*36*
		%	*24.0%*	*17.3%*	*6.7%*	*48.0%*
	Male	*n*	*7*	*12*	*20*	*39*
		%	*9.3%*	*16.0%*	*26.7%*	*52.0%*
Total		*n*	*25*	*25*	*25*	*75*
		%	*33.3%*	*33.3%*	*33.3%*	*100.0%*

Source: Research Data (2020)

The results of the study in Homa Bay County corroborated Ragasa (2012) report, which stated that women embrace new technologies considerably more slowly than males do because of inequalities in how easily they can acquire information about technology advancements and complementary input and services. The findings have implication especially to development agencies with interventions geared towards empowering both men and women. Further corroboration by (Obisesan, 2014), study indicated a higher adoption level among male farmers as compared to their female counterparts. Although Siaya and Kisumu Counties findings were on in line with (Halloran, 2017) study which showed that more women were much more willing to adopt the cricket farming than men.

Low participation of women observed in cricket farming could have been occasioned by household and decision-making role, which limited their time for cricket farming.

4.2.2 Age structure of the respondents by County

The respondents were asked to state their ages, which were classified under different categories. The overall findings revealed that in Siaya middle-age group between 36-60 years old had majority (68.0%) of the respondents. This was followed by young respondents < 36 years' old who constituting (28.0%) of the respondents. A relatively small percentage (4.0%) of respondents were in the elderly age category of above 60 years old. The age structure among respondents in Kisumu County showed majority (52.0%) of respondents were in the middle age bracket of between 36-60 years old while (32.0%) of respondents were in the youth age bracket of < 36 years old. The elderly age bracket had a paltry (16.0%) of respondents who were above 60 years old. The age category distribution among respondents in Homa Bay county indicated that majority (40.0%) of respondents were in the youth age category of < 36 years old and (36.0%) of respondents were in the middle age category of between 36-60 years old. The least represented age category among respondents in the county were elderly above 60 years who had (24.0%) of the respondents identified with the age group (Table 3).

Table 3: *Respondents ages structures distribution by County*

Variables			County			Total
			Siaya	Kisumu	Homa Bay	
Age	<35 years (Young)	*n*	*7*	*8*	*10*	*25*
		%	*28.0%*	*32.0%*	*40.0%*	*33.3%*
	36 - 60 Years (Middle)	*n*	*17*	*13*	*9*	*39*
		%	*68.0%*	*52.0%*	*36.0%*	*52.0%*
	> 60 years (Old)	*n*	*1*	*4*	*6*	*11*
		%	*4.0%*	*16.0%*	*24.0%*	*14.7%*
Total		*n*	*25*	*25*	*25*	*75*
		%	*100.0%*	*100.0%*	*100.0%*	*100.0%*

Source: Research Data (2020)

The overall analysis showed that across the study area, middle age farmers of between 36-60 years were the majority followed by young farmers who were below 36 years,

which was only an exception in Homa Bay County. The elderly respondents of above 60 years were the minority; this could have been attributed to the fact that the middle age farmers could have viewed cricket farming as a long-term enterprise, which required more time. The finding gave a clear understanding on the age group category in the community, which could be targeted for any development activity. This finding was found to be in line with (Dhraief et al.,2018) study which revealed that younger farmers are less risk-averse and are always willing to try new technologies as compared to older farmers who have an increase in risk aversion and a decreased interest in long-term investment in the farm. The overall analysis further revealed that majority (52.0%) of respondents who are in cricket farming are middle-age farmers and not young people who still have energy to farm, this could have been attributed to by low returns and risks involved in cricket farming.

4.2.3 Education level of cricket farmers by County

From the findings, out of 75 individual respondents interviewed 14 farmers in Siaya County had secondary education at (56.0 %) of the respondents as their highest level of education as compared to 7 in number who had primary education level at (28.0%) of the respondents while post-secondary education represented a minority (16.0%) of the respondents. The education level in Kisumu County indicated that majority (64.0%) of the respondents who were 16 in number had primary education level. This was followed by secondary education level at (24.0%), post-secondary was at ((8.0%) of the respondents, while a meager (4.0%) of the respondents had no formal education.

In Homa Bay County a majority (48.0%) of the respondents had secondary as their highest level of education, respondents with primary and post-secondary were at (24.0%) respectively, with small percentage of (4.0%) of respondents in the county having no formal education. Table 4 shows the distribution of the respondents with respect to education level across the three counties.

Table 4: *Level of Education attained by respondents per County.*

Variables			County			
			Siaya	Kisumu	Homa Bay	Total
Highest level of education attained	No formal Education	*n*	*0.0*	*1*	*1*	*2*
		%	*0.0%*	*4.0%*	*4.0%*	*2.7%*
	Primary	*n*	*7*	*16*	*6*	*29*
		%	*28.0%*	*64.0%*	*24.0%*	*38.7%*
	Secondary	*n*	*14*	*6*	*12*	*32*
		%	*56.0%*	*24.0%*	*48.0%*	*42.7%*
	Post-Secondary	*n*	*4*	*2*	*6*	*12*
		%	*16.0%*	*8.0%*	*24.0*	*16.0%*
Total		*n*	*25*	*25*	*25*	*75*
		%	*33.3%*	*33.3%*	*33.3%*	*100.0%*

Source: Research Data (2020)

Further findings revealed that the majority of cricket farmers were secondary education holders as compared to those who had no formal education and post-secondary education, this probably contributed to accessing more information either through trainings, from fellow farmers or through research. No finding was noted that the either of the education levels influenced cricket farming among farmers. The study finding is supported by (Usman, 2016) report, which showed that educated farmers have high level of understanding, which helps them in decision-making. Usman further argued that farmers with higher education probably did not find the practice to be motivating and lucrative enterprise thus resulting to their low adoption rate.

4.2.4 Household Head by County

The goal of the study was to examine at the distribution of respondents by household head. This made it possible to determine whether the respondents' position as the head of the household had any effect on their decision to pursue cricket farming. Out of 120 respondents, 75 individual respondents interviewed through quantitative method, Kisumu County had a majority (92.0%) of the household respondents who were 23 in number headed by males, while a minority of (8.0%) of households were female headed. The study indicated that in Siaya County the majority (76.0%) of the respondents were from male headed households, (20.0%) of the respondents were from female headed households while the youth headed households accounted for (4.0%) of the total

respondents. The majority (60.0%) of respondents in Homa Bay County were male who were 15 in number were from male headed household, (28.0%) of respondents were from female household while youth headed households represented a meager (12.0%) of the respondents. Detailed statistics as to the household heads across the three counties are as shown in the *table 5* below:

Table 5: *Distribution of Respondent's Family Household head by County*

			County			
	Variables		Siaya	Kisumu	Homa Bay	Total
Household head	Male headed	*n*	*19*	*23*	*15*	*57*
		%	*76.0%*	*92.0%*	*60.0%*	*76.0%*
	Female headed	*n*	*5*	*2*	*7*	*14*
		%	*20.0%*	*8.0%*	*28.0%*	*18.7%*
	Youth headed	*n*	*1*	*0*	*3*	*4*
		%	*4.0%*	*0.0%*	*12.0%*	*5.3%*
		n	*25*	*25*	*25*	*75*
Total		*%*	*100.0%*	*100.0%*	*100.0%*	*100.0%*

Source: Research Data (2020)

The overall findings showed that majority of cricket farmers were male-headed households at (76.0%) while youth headed household represented the least percentage at (5.3%), this could have been attributed to cultural values and decision-making attached to new technologies thus may have effects on community projects. The finding was similar to (Melisse, 2018), study which showed that due to the prevailing socio-cultural values and norms males have the freedom of mobility, and participate in different meetings and trainings thus increasing their adoption capacity. Melisse further argued that male-headed households have more access to information as compared to female-headed households and capacity to influence cultural norms and traditions.

4.2.5 Marital Status distribution by County

The study looked at the distribution of respondents by marital status. Out of 75 individual respondents interviewed, Siaya County had majority (25.3%) of respondents who were married, (6.7%) of the respondents were widow while (1.3%) of respondents were single. The marital status distribution in Kisumu County revealed that the majority (29.3%) of respondents were married, (2.7%) of respondent were widow while (1.3%) of

the respondents were in single. While in Homa Bay County civil status distribution indicated that the majority (18.7%) of respondents were married, followed by (9.3%) of respondents who were widow with relatively a small percentage of (5.3%) of the respondents who were single. The marital status of the respondents by County is shown in the *figure 4* below:

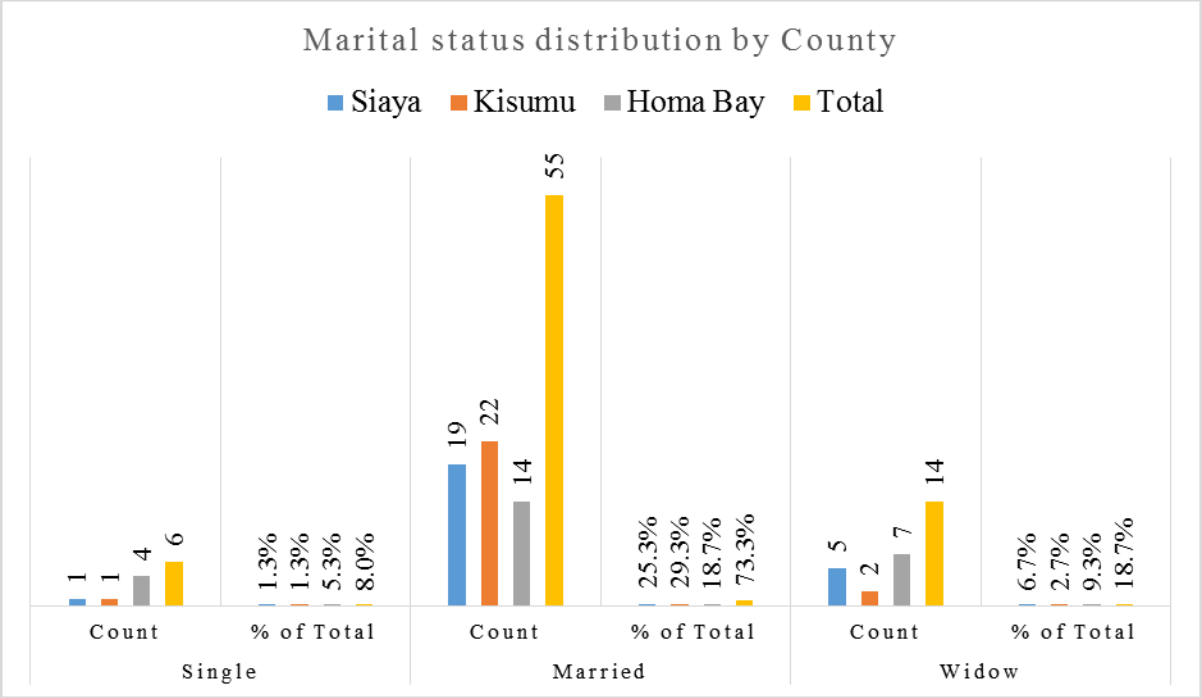

Figure 4: *Marital Status Distribution by County*

Source: Research Data (2020)

4.2.6 Religious Affiliation status distribution by County

The study looked at the distribution of respondents by their religious affiliations. Out of 75 respondents interviewed across the three counties, the study showed that Siaya County had (100.0%) of the respondents were affiliated to Christianity. Similar case was observed in Kisumu County where a majority (100.0%) of the respondents were Christians. Homa Bay County showed a contrary result whereby (92.0%) of the respondents were Christians while a meager (8.0%) of the respondents were from other religions. The study further revealed that (97.3%) of the respondents interviewed were Christians with relatively a smaller percentage of (2.7%) of the respondents affiliated to

other religions. The *figure 5* below depicts the distribution of respondents by their religion affiliation:

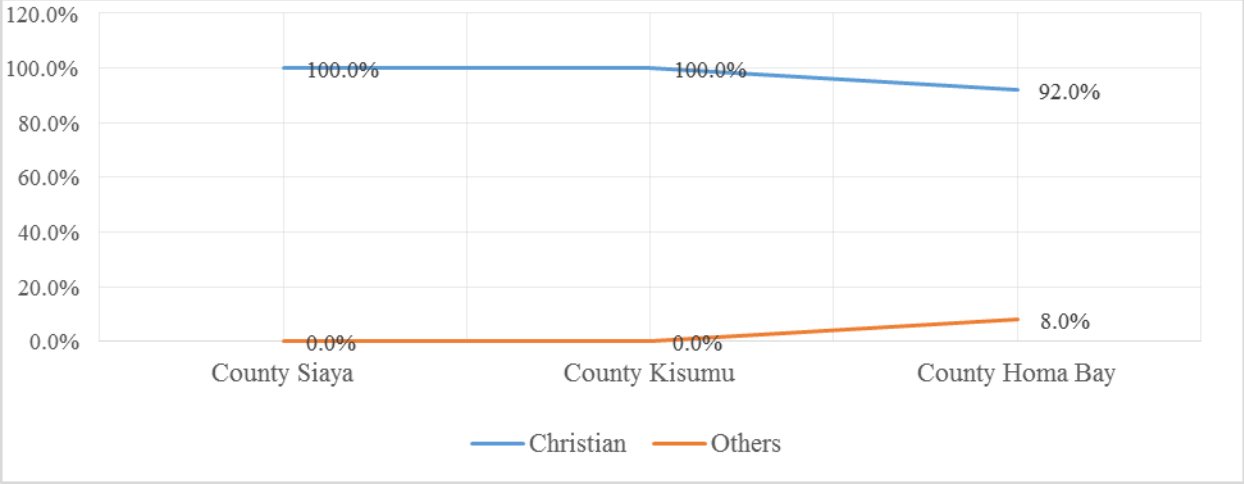

Figure 5: *Distribution of Respondents Religious affiliation by County*

Source: Research Data (2020)

The overall finding indicated that religious affiliation has minimal impact on cricket farming. The findings support (DaVince Tools, 2004), study which revealed that historically insects are referred to as food in Leviticus chapter 11, verse 22 and in Matthew chapter 3, verse 4.

4.2.7 Household Size distribution by County

The study established that Siaya County had majority (20.0%) of the respondent with small family size less than 5, (12.0%) of the respondents were from middle size family between 6-10 in number while the large family more than 10 in number accounted to (1.3%) of the respondents. The size of household distribution in Kisumu county revealed that (18.7%) of the respondents had households with small size family less than 5 persons, (13.3%) had between 6-10 persons while (1.3 %) had more than 10 persons. The household size distribution in Homa Bay County revealed that the majority (14.7%) of the respondents had less than 5 persons per household, (13.30%) of the respondents had household size with families between 6-10 in number while least was large family with more than 10 persons which reported (5.3%) of the respondents, as shown in *figure 6* below:

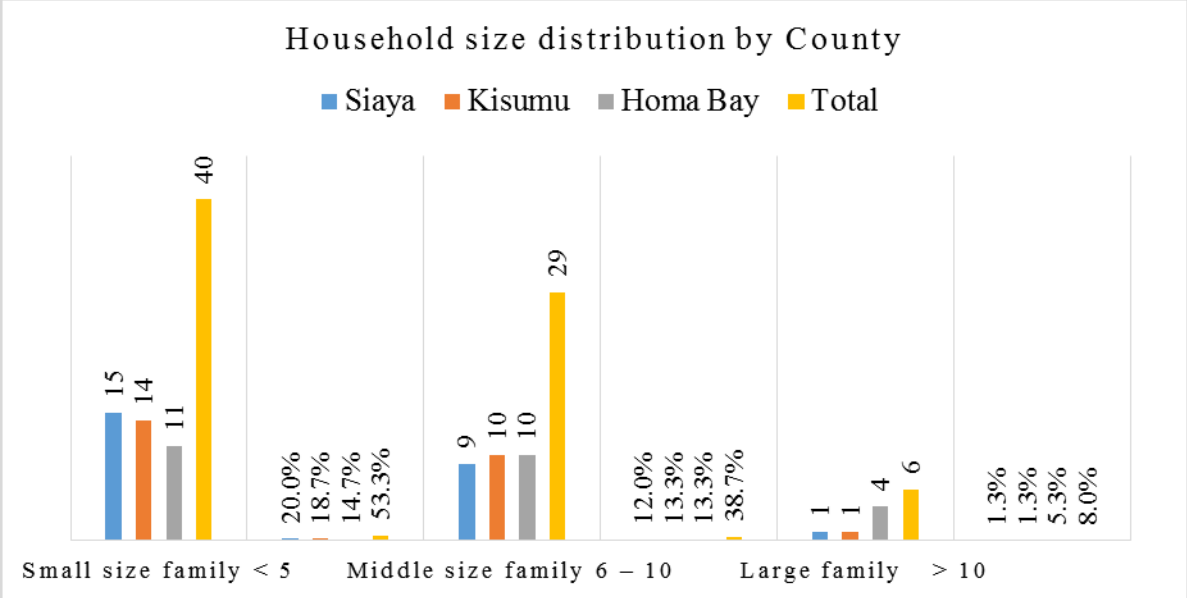

Figure 6: *Household Size distribution by County*

Source: Research Data (2020)

The finding revealed that a majority (53.3%) of the respondents had small family size of less than 5 persons per household, while a meager (8.0%) of the respondents has large family size with more than 10 persons. This means that majority of household size had small family size thus could have denied most farmers the opportunity of enjoying economic to scale in terms of labour force towards adopting cricket farming. This study is in line with (Donkoh et al., 2019) indicated that household size play significant role, (Kelebe et al., 2017) such as provision of labour force which could influence adoption of new technology.

4.2.8 Farm size distribution by County

The study established that Siaya County majority ((14.7%) of the respondents had between 0.26-1 acre and more than 1 acre respectively, while small proportion of (4.0%) of the respondents had less than 0.25 acre of farm size. Kisumu County registered a majority (12.0%) of the respondents with farm sizes between 0.26-1 acre and more than 1 acre respectively, (9.3%) of the respondents had farm size of less than 0.25. While farm size distribution in Homa Bay County indicated that, a majority (24.0%) of the respondents had farm size of less than 0.25 acres with a minority (2.7%) of respondents

having farm size more than 1 acre. A detailed statistic regarding the farm sizes across the concerned counties as shown in the *figure 7* below:

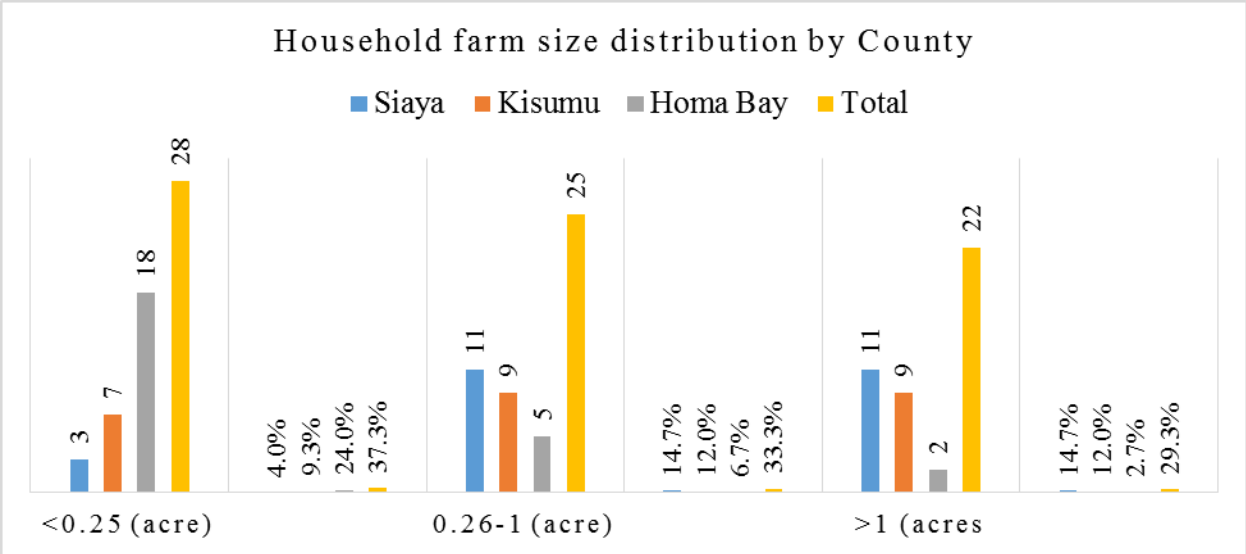

Figure 7: *Household farm size distribution by County*

Source: Research Data (2020)

The finding showed that the majority (37.3%) of cricket farmers had small farm sizes less than 0.25, while a meagre (29.3%) of respondents had more than 1 acres, this could have contributed to a reduction of number of farmers who were willing to venture into cricket farming but had reservation based on the size of land the enterprise would take. The findings support (Udimal et al., 2017) □ study, which argued that farm size highly, contributes to farmers' adoption of new technology.

4.2.9 Main Source of Livelihood distribution by County

The study established that Kisumu County registered a majority (72.0%) of the respondent whose main source of livelihood was crop farming, while a small proportion (28.0%) of the respondents had business as their main source of livelihood. The study also indicated that in Siaya County a majority (48.0%) of the respondents had crop farming as their main source of livelihood, (40.0%) of the respondent had business as their main source of income, (8.0%) from livestock while (4.0%) of the respondents had employment as their main source of livelihood. The main source of livelihood

distribution in Homa Bay showed that a majority (36.0%) of the respondents had crop farming as their main source of livelihood, (32.0%) of respondents had business as their main source of livelihood, (28.0%) of respondents were getting their livelihood from employment while a paltry (4.0%) of respondent had livestock as their main source of livelihood. The distribution of respondents by their main source of livelihood as depicted in the *table 6* below:

Table 6: *Respondents' Main Source of Livelihood distribution by County*

Variables			County			Total
			Siaya	Kisumu	Homa Bay	
Main source of livelihood	Employment	*n*	*1*	*0*	*7*	*8*
		%	*4.0%*	*0.0%*	*28.0%*	*10.7%*
	Business	*n*	*10*	*7*	*8*	*25*
		%	*40.0%*	*28.0%*	*32.0%*	*33.3%*
	Livestock farming	*n*	*2*	*0*	*1*	*3*
		%	*8.0%*	*0.0%*	*4.0%*	*4.0%*
	Crop farming	*n*	*12*	*18*	*9*	*39*
		%	*48.0%*	*72.0%*	*36.0%*	*52.0%*
Total		*n*	*25*	*25*	*25*	*75*
		%	*100.0%*	*100.0%*	*100.0%*	*100.0%*

Source: Research Data (2020)

The overall findings revealed that the majority (52.0%) of cricket farmers had crop farming as their main source of livelihood with a small proportion of (4.0%) of respondents having livestock farming as their main source of livelihood. This was in line with (USAID, 2018; MoALF, 2016a) which reported that crop production is the main source of livelihood to farmer in Siaya, Homa Bay and Kisumu. The indicated existence of verse opportunity for farmers in terms of cricket feeds that could helped them sustain cricket-farming projects at their household level.

4.2.10 Respondents' Annual Income distribution by County

The objective of the study was to look at the distribution of respondents by their total annual income. This was to help the study establish whether the total annual income had influence of adoption of cricket farming. From 75 respondents interviewed, Homa Bay County had majority (80.0% of the respondents who were getting low income of less than KES 50,000, as compared to (8.0%) of the respondents who were getting medium income

of between KES 51,000 – KES 100,000 while only (12.0%) of the respondents who were getting upper income of more than KES 100,000. The finding revealed that the majority of farmers were getting below fifty thousand as their annual income with a minority of 8.0% getting annual income above KES. 100,000. Kisumu County had a majority (64.0%) of the respondents who had their annual income less than KES 50,000, while (36.0%) of the respondents reported their annual income to be between KES 51,000-100,000. Siaya County registered a majority ((48.0%) of the respondents with annual income less that KES 50,000, (40.0%) of the respondents had their annual income falling between KES 51,000-100,000 while a meager (12.0%) of the respondents had their annual income above KES 100,000 as shown in *table 7* below:

Table 7: *Income Distribution of Respondents by County*

			County			
	Variables		Siaya	Kisumu	Homa Bay	Total
Annual income	Low income < 50,000	*n*	*12*	*16*	*20*	*48*
		%	*25.0%*	*33.3%*	*41.7%*	*64.0%*
	Medium income 51,000 - 100,000	*n*	*10*	*9*	*2*	*21*
		%	*47.6%*	*42.9%*	*9.5%*	*28.0%*
	Upper income > 100,000	*n*	*3*	*0*	*3*	*6*
		%	*50.0%*	*0.0%*	*50.0%*	*8.0%*
Total		*n*	*25*	*25*	*25*	*75*
		%	*33.3%*	*33.3%*	*33.3%*	*100.0%*

Source: Research Data (2020)

The study findings revealed that majority (64.0%) of the respondents had their annual income less than KES 50,000 while only (8.0%) of the respondents had their annual income above KES 100,000. The findings were much lower than (USAID, 2018; MoALF, 2016a) reports which showed that the mean annual total household income in Siaya was KES 124,286, in Homa Bay on average household income was KES. 82,482 while in Kisumu annual household income on average was KES 98,496. The findings present annual income of below Kshs. 50,000, which could have been a major barrier to many farmers especially in setting up cricket units.

4.2.11 Respondents Income from Cricket farming distribution by County

The study interviewed 75 respondents, of which a majority (28.0%) of the respondents in Siaya County did not get any income from cricket farming, with a small proportion of (5.3%) of the respondents who realized KES 1- KES 10,000 from cricket farming. The income from cricket farming distribution in Kisumu indicated that a majority (22.7%) of the respondents had between KES 1 – KES 10,000 as part of their income from cricket farming while (10.7%) of the respondents did not register any income from cricket farming. In Homa Bay, the study revealed that majority (28.0%) of the respondents confirmed that they had not gotten any income from their cricket farming, while (2.7%) of the respondents reported having obtained income between KES 1 – KES 10,000 and more than KES 10,000 respectively as illustrated in the *figure 8* below.

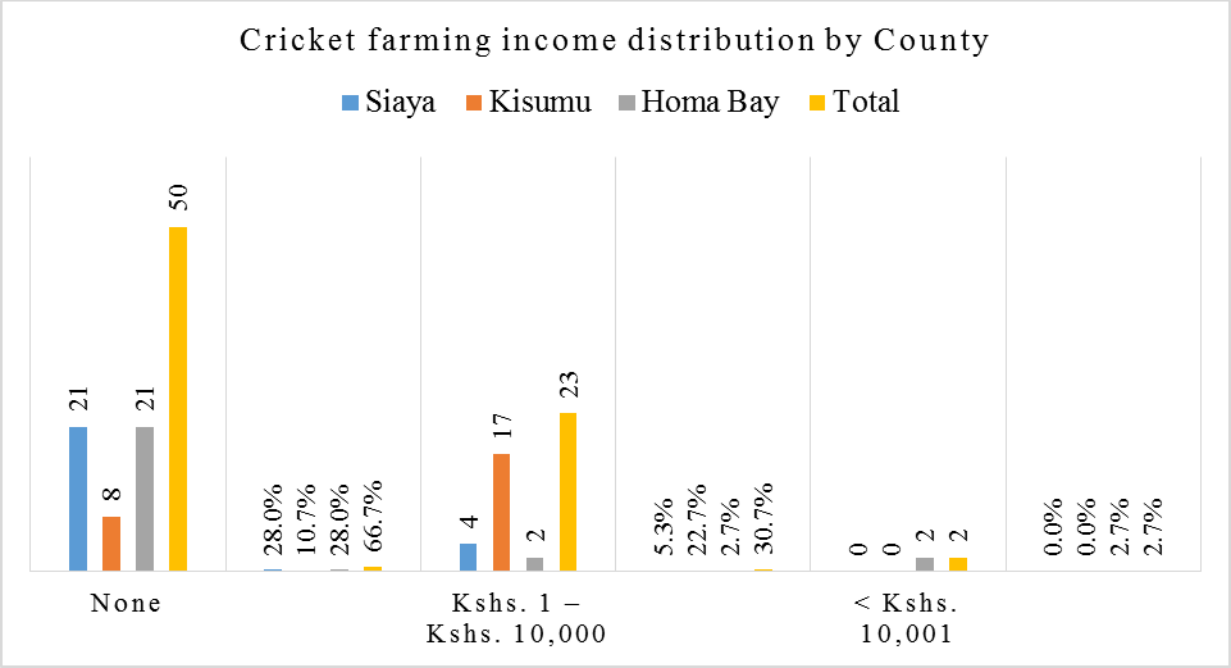

Figure 8: *Cricket Farming Income distribution by County*

Source: Research Data (2020)

The further findings showed that the majority (66.7%) of the respondents did not earn any income from their cricket farming while only (2.7%) of the respondents had gotten more than KES 10,000 from their cricket farming, this could have been due to desertion of the enterprise by farmers owing to lack of market resulting from low income. The finding was in consistence with (T. et al., 2018) study which found that improved market

access for cricket farmers was likely to contribute to increased household income and consequently increasing adoption. Further study by (Ayieko et al., 2016b) revealed that the main attraction and concern for farmers on edible insect farming in Kenya is food and income hence could have influence on their rearing.

4.3 Level of Acceptance of Cricket consumption as food

The study sought to establish the acceptability level of cricket consumption by respondents. This helped the study to understand how different variables such as cultural beliefs, perception and attitude as well as awareness and availability of cricket to farmers' influence adoption of cricket farming.

4.3.1 Awareness on Cricket consumption distribution by County

The overall study findings revealed that, (100.0%) of the respondents affirmed that they are aware of cricket consumption as food and feed. When asked whether they have eaten crickets, (80.0%) of respondents from Siaya County (96.0%) of the respondents from Kisumu County and ((92.0%) of the respondents from Homa Bay County respectively confirmed that they have eaten cricket.

In further interview (11.0%) of the respondents who had not eaten crickets were asked what prevented them from eating cricket as food, from Siaya County a majority (60.0%) of the respondents reported that they have not eaten crickets because they are unsafe while (40.0%) of respondent said they have never eaten crickets because of their presentation status. In Homa Bay County (50.0%) of the respondents reported that it is because of presentation status while the remaining proportion of 50.0% said that crickets are unsafe to eat.

Further probing done revealed that, a majority (80.0%) of the respondents from Siaya County get cricket for food and feed for their household consumption from the wild, (10.0%) of the respondents confirmed getting crickets for their household consumption from their own farm while a mere (5.0%) of the respondents were getting crickets for their household consumption from neighbours. Findings from Kisumu County also

indicated that (66.6 %) of the respondents get cricket for their household consumption from their own farms, with a marginal (4.1%) of respondents getting cricket for their household consumption from market. Almost similar trend was observed in Homa Bay County where a majority of (69.5%) of respondents were getting crickets from their own farms with only (4.3%) of the respondents getting crickets for their household consumption from the wild. The *table 8* below source of crickets for household consumption:

Table 8: *Household cricket access distribution by County*

	Variables		County			
			Siaya	Kisumu	Homa Bay	Total
Access of crickets for household consumption	Own farm	*n*	*2*	*18*	*16*	*36*
		%	*10.0%*	*75.0%*	*69.6%*	*53.7%*
	Market	*n*	*0*	*1*	*4*	*5*
		%	*0.0%*	*4.2%*	*17.4%*	*7.5%*
	Neighbours	*n*	*1*	*3*	*2*	*6*
		%	*5.0%*	*12.5%*	*8.7%*	*9.0%*
	Wild	*n*	*17*	*2*	*1*	*20*
		%	*85.0%*	*8.3%*	*4.3%*	*29.9%*
Total		*n*	*20*	*24*	*23*	*67*
		%	*100.0%*	*100.0%*	*100.0%*	*100.0%*

Source: Research Data (2020)

The study findings showed that (100.0%) of the respondents were aware of cricket consumption as food, where a majority (89.3%) of the respondents confirmed having eaten crickets. However, findings on access to household consumption indicated that a majority (53.7%) of the respondents were getting crickets from their own farm, (29.9%) of the respondents were getting their crickets from wild, (9.0%) of the respondent were getting crickets from neighbours with only a marginal (7.5%) of the respondents confirmed getting crickets from the market for their household consumption. This means that structure on cricket commercialization especially within the local markets are yet to be developed thus could affects its adoption.

Further probing of the respondents showed that the awareness created had not translated to adoption of cricket farming among farmer across the three counties, as majority of

farmers were found to have opted out of the enterprise. The finding was in line with (Hoek et al., 2011) study which revealed that providing information and increasing awareness alone on consuming meat substitutes such as crickets is not enough to increase adoption process.

4.3.2 Consumption of Cricket as Food distribution by County.

The results from the study showed that majority (26.7%) of respondents from Siaya County had consumed cricket with a small proportion (6.7%) of respondents who reported that they have not consumed crickets. Kisumu County registered a slightly higher number (32.0%) of respondents who had consumed crickets, with a paltry ((1.3%) who confirmed that they have not eaten cricket. While in Homa Bay County a majority (30.7%) of respondent affirmed that they had consumed cricket, this saw only ((2.7%) of the respondents who had not eaten crickets as indicated in table 9 below:

Table 9: *Distribution of respondents who have consumed cricket by County*

			County			
Acceptability to consumption	Variables		Siaya	Kisumu	Homa Bay	Total
Have you ever eaten cricket?	no	*n*	5	1	2	8
		%	6.7%	1.3%	2.7%	10.7%
	yes	*n*	20	24	23	67
		%	26.7%	32.0%	30.7%	89.3%
Total		*n*	25	25	25	75
		%	33.3%	33.3%	33.3%	100.0%

The overall findings showed that (89.3%) of the respondents had consumed crickets across the three study counties with a proportion of (10.7%) of respondent who said they had not consumed crickets. The results indicated that more farmers would be willing not only to accept crickets for adoption for farming but also for consumption thus would create important opportunity for any agency interested in promoting cricket farming at community level.

Further findings revealed that out of (89.3%) who confirmed that they had consumed cricket, that a majority (79.0%) of the respondents from Kisumu County said that they have eaten cricket in their houses, (20.8%) of the respondents were in affirmative that they have eaten cricket in seminar. In Homa Bay County the study revealed that (61.0%)

of the respondents had eaten crickets at seminar as compared with a marginal (39.0%) of the respondents who confirmed having eaten crickets in their house. Similar trend was also observed in Siaya County where majority (70.0%) of the respondents confirmed having eaten crickets at seminar with only (30.0%) of respondents confirming that they have eaten crickets in their houses. The study findings showed that majority (50.7%) of farmers had eaten crickets; this could have been informed by repeated consumption of crickets or cricket products. This was in line with (Lensvelt & Steenbekkers, 2014) study showed that consumer acceptance of entomophagy, can only be increased by consumers themselves with the opportunity to trying insects.

When asked how frequently they eat crickets, the study established that in Siaya County majority (100.0%) of the respondents had eaten cricket once. The study also revealed that majority (41.6%) of the respondents had eaten crickets twice, (33.3%) of the respondents had eaten cricket once while a meager (25.0%) of the respondents had eaten cricket more than three times. In Homa Bay County (82.0%) of the respondents had eaten cricket once with a marginal (17.3%) of respondents having eaten crickets more than three times. The *figure 9* below shows the monthly frequency across the different three counties.

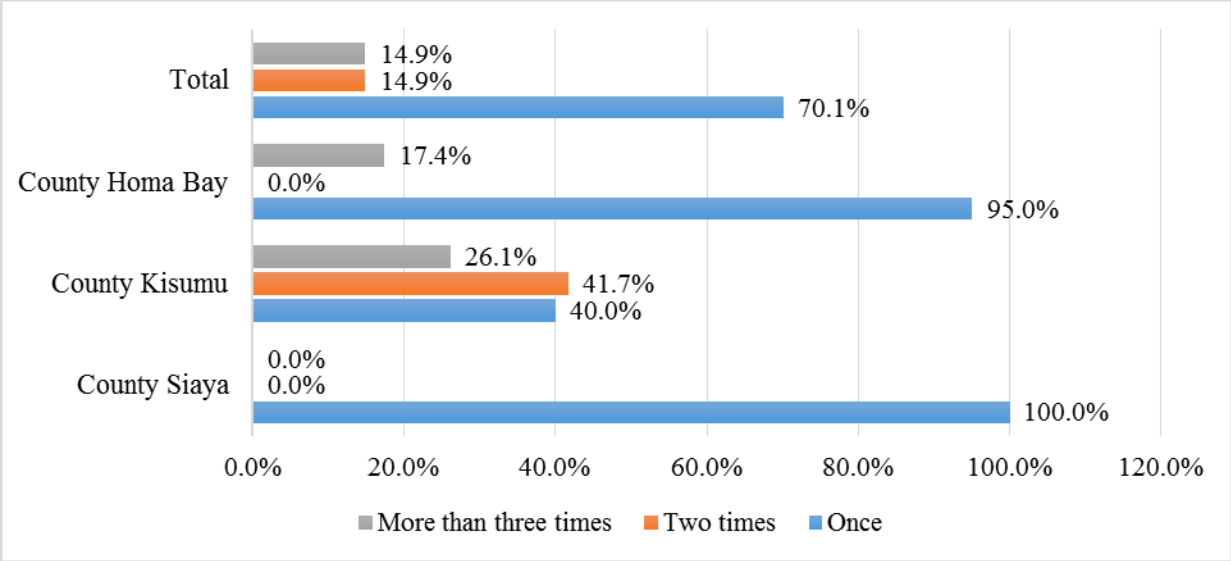

Figure 9: *Distribution of Frequency of Cricket Consumption by County*

Source: Research Data (2020)

Though overall findings showed that the majority (70.0%) of farmers had eaten crickets only once, this could have contributed negatively to adoption due to lack of previous experience with cricket consumption. Similar findings were also reported by (Halloran, 2017), who argued that previous consumption of crickets positively influences the awareness and subsequent adoption to cricket farming.

4.3.3 Cultural beliefs on cricket consumption distribution by County

The study sought to look at the distribution of respondents by their cultural beliefs on cricket consumption. The interest of the study was to establish whether respondents' cultural beliefs had influence on adoption of cricket farming. The study interviewed 75 respondents across the three counties of which the findings revealed majority (56.8%) of the respondents in Siaya County confirming that they had cultural beliefs attached to cricket consumption while (10.6%) of the respondents reported that they had no cultural beliefs attached to cricket consumption. In Kisumu County the study showed that (44.7%) of the respondents had cultural beliefs attached to cricket consumption while (21.6%) affirmed that they do not have any cultural belief attached to cricket consumption. Similar findings were also observed in Homa Bay County where majority (44.7%) of the respondent indicated that they had no cultural beliefs attached to cricket consumption while (21.6%) of the respondents confirmed that they had cultural beliefs attached to cricket consumption as shown in the *table 10* below:

Table 10: *Cultural beliefs on cricket consumption by County*

Variables			*County*			
			Siaya	*Kisumu*	*Homa Bay*	*Total*
Do you have any cultural value attached to cricket consumption?	*No*	*n*	*21*	*8*	*8*	*37*
		%	*56.8%*	*21.6%*	*21.6%*	*49.3%*
	Yes	*n*	*4*	*17*	*17*	*38*
		%	*10.6%*	*44.7%*	*44.7%*	*50.6%*
Total		*n*	*25*	*25*	*25*	*75*
		%	*33.3%*	*33.3%*	*33.3%*	*100.0%*

Source: Research Data (2020)

The overall findings showed that the majority (50.6%) of farmers had cultural beliefs attached to cricket consumption, which largely could have contributed to its low

consumption and subsequent adoption, by smallholder farmers hence indicating areas to be considered by any development agencies intending to implement cricket farming project. This was in support to finding from group interviews and extension workers from MoALF and ADS. Similar findings were also reported by (Lekhanya, 2013) study, which found that culture to be a major constrain to acceptability and adoption of new farming technology such as cricket farming.

4.3.4 Perception and attitudes to Cricket consumption

The study looked at the respondent distribution by their perception and attitudes to cricket farming. This was to help the study establish whether perception and attitude of the respondents had influence on the adoption of cricket farming. A total of 120 respondents interviewed on their extent of agreement with a number of statements regarding cricket eating. However, out of 75 individuals interviewed, a majority of (36.0%) of the respondents reported that eating cricket makes them sick, this was followed by (25.4%) of the respondents who said that if cricket crawls on their food they will not eat it. A relatively a smaller percentage (20.2%) of the respondents agreed that eating crickets is disgusting while (15.8%) of the respondents agreed that crickets are sweet and tender than poultry. A paltry of (2.6%) of the respondents reported that crickets are good source of protein than beef as depicted in the *table 11* below:

Table 11: *Trends of perception and attitude to cricket consumption by County*

		Responses		
	Variables	*N*	*Percent*	*Percent of Cases*
Perception and attitude on Cricket Consumption	Crickets are good source of protein than beef.	*3*	*2.6%*	*4.9%*
	Eating crickets is disgusting	*23*	*20.2%*	*37.7%*
	Crickets are sweet and tender than poultry.	*18*	*15.8%*	*29.5%*
	If a cricket crawls on my food then I will not eat it.	*29*	*25.4%*	*47.5%*
	Eating crickets make me sick.	*41*	*36.0%*	*67.2%*
Total		*114*	*100.0%*	*186.9%*

Source: Research Data (2020)

Further findings revealed that the majority of farmers did not regard crickets as food thus this could have been influenced by the attitude, which farmers had developed towards cricket consumption thus affecting its farming at household level. This therefore calls for more trainings on cricket's utilization as human food. The finding is in concurrent with (Ogunsumi, 2011) study, which indicated that attitude influence farmers' acceptance or rejection of a new technology. This largely depends on how the technology is presented to the farmer. Li et al., (2020) study findings, revealed that positive attitude toward technology, are more likely to motivate farmers to adopt new technologies in practice and further support this.

4.3.5 Availability of Crickets to household

The aim of the study was to examine the distribution of respondents based on the availability of crickets to households. This was done to enable the study in determining whether the availability of crickets to the households of the respondents had an impact on the adoption of cricket farming. In light of this, 75 respondents were asked as to how easily their households might obtain crickets. Findings from the study revealed that the majority (91.7%) of the respondents in Kisumu County were in agreement that crickets are readily available with a paltry of (8.3%) of the respondents who reported that crickets were not available for ease of access by their households. In Siaya County the study revealed that (55.0%) of the respondents were in affirmative that crickets are readily available while (45.0%) of the respondents said that crickets are not available for their household. The results were different in Homa Bay County, where the majority of respondents (73.9%) said that their households did not have access to crickets, and just a small percentage of respondents (26.1%) said that their households do. This demonstrates that a majority of respondents (58.2%) confirmed that crickets are easily accessible, while a portion of respondents (41.8%) reported that crickets are not readily available. These proportions may have influenced consumption and the adoption of cricket farming for food and feed at the household level. This was in line with (House, 2016; Pambo et al., 2016a) study findings which revealed that availability of edible insects for food is among the barriers for acceptance of insect consumption. Detailed

availability for ease of access by the household's statistics are shown in the *table 12* below:

Table 12: ***Availability of crickets to households by County***

			County			
			Siaya	Kisumu	Homa Bay	Total
Available cricket.	Readily ofavailable	Count	11	22	6	39
		% within County	55.0%	91.7%	26.1%	58.2%
	Not available	Count	9	2	17	28
		% within County	45.0%	8.3%	73.9%	41.8%
		Count	20	24	23	67
Total		% within County	100.0%	100.0%	100.0%	100.0%

Source: Research Data (2020)

4.4 Contribution of Cricket to household food security

4.4.1 Cricket farming distribution by County

The study sought to look at the distribution of respondents farming crickets. This helped the study established the number of farmers who have adopted cricket farming as alternative income, food and employment source. Respondents were further asked if they engaged in Cricket farming or not. From the household interviews, Siaya County had (16.0%) of the respondents who confirmed that they farm crickets, while (84.0%) of the respondent were not farming crickets. The study findings in Kisumu County revealed that only a minority (32.0%) of the respondents were farming crickets while a majority of (68.0%) were not farming crickets. The cricket farming distribution in Homa Bay indicated that a meager (25.3%) of the respondents were farming cricket as compared to the majority (72.0%) of the respondents who were not farming crickets as shown in *table 13* below:

Table 13: *Cricket farming by County*

Variables			**County**			
			Siaya	Kisumu	Homa Bay	Total
Do you farm cricket	No	*n*	*21*	*17*	*18*	*56*
		%	*84.0%*	*68.0%*	*72.0%*	*74.7%*
	Yes	*n*	*4*	*8*	*7*	*19*
		%	*16.0%*	*32.0%*	*28.0%*	*25.3%*
Total		*n*	*25*	*25*	*25*	*75*
		%	*100.0%*	*100.0%*	*100.0%*	*100.0%*

Source: Research Data (2020)

The overall findings showed that majority (74.7%) of respondents were not farming cricket with adoption rate of (25.3%) of the respondents who reported that they are farming crickets. Although most farmers showed interest and joined the cricket farming at inception, the majority opted out citing low prices, lack of market for crickets as well as regular extension service from the project implementers.

4.4.2 Frequency of Cricket sale distribution by County

Among the 19 farmers who were in active production, the study sought to establish their frequency of selling crickets as a source of income. In Siaya County a majority (75.0%) of the respondents reported that they sell their crickets twice a month while (25.0%) of the respondents were found to be selling their crickets every month. In Kisumu County the study indicated that a majority of (50.0%) of the respondents sell their crickets twice a month, (12.5%) of the respondents were selling their crickets every month followed by (37.5%) of the respondents who affirmed that they sell their crickets more than thrice a month. The frequency of cricket sale distribution in Homa Bay County revealed that a majority (71.4%) of the respondents sell their crickets twice a month with a minority (28.6%) of the respondents reporting that they sell their cricket every month. The *table 14* below shows the frequency of cricket sales by respondents.

Table 14: *Frequency of cricket sale by County*

			County			
			Siaya	*Kisumu*	*Homa Bay*	*Total*
How frequently do you sell your cricket?	*Every month*	*n*	*1*	*1*	*2*	*4*
		%	*25.0%*	*12.5%*	*28.6%*	*21.1%*
	Twice a month	*n*	*3*	*4*	*5*	*12*
		%	*75.0%*	*50.0%*	*71.4%*	*63.2%*
	More than thrice a month	*n*	*0*	*3*	*0*	*3*
		%	*0.0%*	*37.5%*	*0.0%*	*15.8%*
Total		*n*	*4*	*8*	*7*	*19*
		%	*100.0%*	*100.0%*	*100.0%*	*100.0%*

Source: Research Data (2020)

The overall findings implied that the majority (63.2%) of farmers were not in active production of crickets hence this affected the quantity of crickets produced as well as those taken to the market for sale. This affected its consumption and consequently its

farming at the household level because farmers felt it was unreliable and unsustainable source of food.

4.4.3 Percentage of income from Cricket farming distribution by County

The study sought to look at the distribution of the 19 respondents in active production by percentage of income, which they earned from cricket farming. This was to help the study establish whether respondents' percentage of income had influence adoption of cricket farming. Out of 19 respondents who had adopted cricket farming, in Siaya County majority (50.0%) of the respondents reported they had earned < 25% from their cricket farming activity, while the remaining (50.0%) of the respondents confirmed that they had earned between 26%-50% from their cricket farming activity. In Kisumu County a majority (75.0%) of the respondents registered percentage income of <25%, (12.5%) of the respondents reported that they earned 26%-50% income from cricket farming while the remaining proportion of (12.5%) confirmed earning more than 51% income from cricket farming. Almost similar findings was presented in Homa Bay County where a majority (71.4%) of the respondents realized <25% of income from cricket farming activity, with (14.3%) of the respondents realizing percentage income of 26%-50% and >50% respectively. The *table 15* below depict percentages of income being realized from cricket farming.

Table 15: *Percentage of income from cricket farming by County*

			County			
			Siaya	Kisumu	Homa Bay	Total
Percentage of income realized as a result of cricket farming	*< 25%*	*n*	*2*	*6*	*5*	*13*
		%	*50.0%*	*75.0%*	*71.4%*	*68.4%*
	26% - 50%	*n*	*2*	*1*	*1*	*4*
		%	*50.0%*	*12.5%*	*14.3%*	*21.1%*
	> 51%	*n*	*0*	*1*	*1*	*2*
		%	*0.0%*	*12.5%*	*14.3%*	*10.5%*
Total		*n*	*4*	*8*	*7*	*19*
		%	*100.0%*	*100.0%*	*100.0%*	*100.0%*

Source: Research Data (2020)

The findings indicated that the majority (68.4%) of farmers were realizing low income of <25% from cricket farming and this could have been attributed to lack of sustainable

market to sell crickets consequently leading to low adoption. This is in line with (Halloran, 2017) study which showed that lack of market can hinder adoption of cricket farming and consequently affecting its income.

4.4.4 Dietary consumption changes as a result of Cricket farming

The study further probed whether cricket farming has made any changes in diets at household level. Out of 75 respondents interviewed, in Siaya County a majority (88.0%) of the respondent reported that they have not had any dietary consumption changes with a small proportion of (12.0%) of respondents reporting changes in their dietary consumption. Kisumu County realized almost a proportionate percentage (60.0%) of the respondents affirming that they have not had any dietary consumption changes as a result of cricket farming, while (40.0%) of the respondents confirmed that they have realized dietary consumption changes. The dietary consumption changes because of cricket farming in Homa Bay indicated a majority (72.0%) of the respondents who reported that cricket farming has not changed their dietary consumption pattern while (28.0%) affirmed that cricket farming has changed their dietary consumption pattern.

The overall findings indicate that the majority (55.0%) of farmers had not realized any change in their dietary consumption as a result of cricket farming, this could have been because most farmers were no longer in active production and had not regard cricket farming as source of protein. This call for regularly and timely delivery of focused extension service to smallholder farmers on production and utilization of cricket as food and feed. This is in concurrent with Weigel et al. (2018) study in Laos, which found that small quantities of crickets (100g of fresh crickets for women, 75g for children 4-6 years, and 50g for children 1-3 years) could provide sufficient levels of macro and micronutrients.

4.4.5 Auxiliary jobs created as a result of Cricket farming distribution by County

The study sought to establish whether cricket farming has created any auxiliary job. The interest of the study was to know whether the auxiliary jobs such as transportation of crickets to the market through boda boda; carpentry/masonry for cricket unit

constructions and other jobs such as farm work, processing, grocery, intermediaries created by cricket farming had influence on adoption of cricket farming. From interviews, Siaya County had a majority (84.0%) of the respondents reported that cricket farming has not created any auxiliary job, (16.0%) of the respondent affirmed that cricket farming has created auxiliary jobs. The study findings indicated that (56.0%) of the respondents in Kisumu County reported that cricket farming has created auxiliary jobs while (44.0%) of the respondents said cricket farming has not created any auxiliary jobs. Majority (60.0%) of the respondent in Homa Bay County affirmed that cricket farming has created auxiliary jobs with (40.0%) of the respondents were of contrary opinion that cricket farming has not created any auxiliary job. The findings revealed that the majority (56.0%) of farmers were not cognizant to auxiliary job created by cricket farming; this could have been due to low production level the few farmers who are farming crickets. The finding was in contrary to Afton Halloran et al., (2017) which indicated that in Countries like Lao and Thailand farmers are occupied in cricket farming as employment and sell their produce to wholesalers who purchase crickets in large quantities to deliver to urban markets. Although this was not the case from the study findings, similar report by (FAO, 2013), have also indicated that insect farming can offer employment and cash income either at small-scale household level or at large industrial production. The *figure 10* below shows distribution of respondents' reaction to auxiliary jobs created by cricket farming.

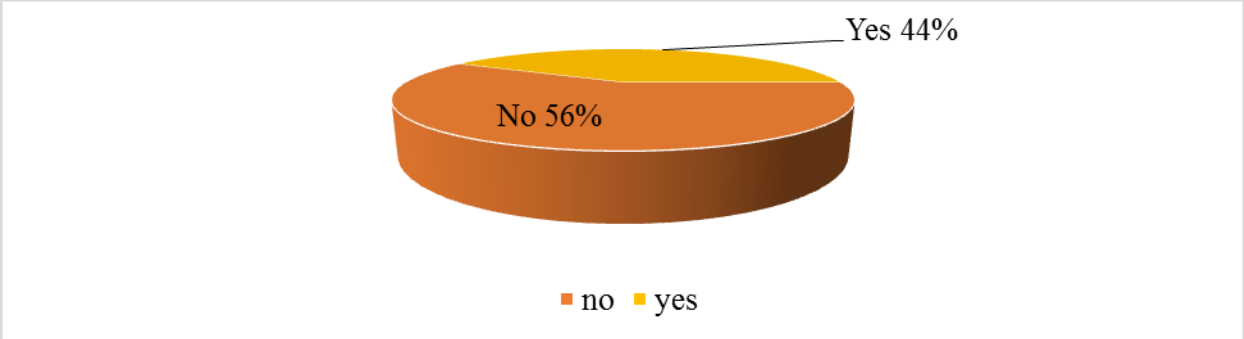

Figure 10: *Auxiliary jobs created as a result of cricket farming by County*

Source: Research Data (2020)

Further probing sought to establish the types of employment by crickets farming. From the interviews interviewed, the study revealed that a majority (50.0%) of the respondents in Homa Bay County were in concurrent that cricket farming has created boda boda

transport as employment, (33.3%) of the respondents reported that cricket farming has created other jobs while (16.7%) of the respondents affirmed that cricket farming has created carpentry and masonry as employment. The findings were contrary in Siaya and Kisumu counties respectively where a majority of (100.0%) of the respondents reported that cricket farming has created other jobs as shown in the *Table 16* below:

Table 16: *Employment created as a result of cricket farming by County*

			County			
			Siaya	Kisumu	Homa Bay	Total
Employment created as a result of cricket farming	Boda Boda transport	*n*	*0*	*0*	*3*	*3*
		%	*0.0%*	*0.0%*	*50.0%*	*37.5%*
	Carpentry/Masonry	*n*	*0*	*0*	*1*	*1*
		%	*0.0%*	*0.0%*	*16.7%*	*12.5%*
	Other jobs	*n*	*1*	*1*	*2*	*4*
		%	*100.0%*	*100.0%*	*33.3%*	*50.0%*
Total		*n*	*1*	*1*	*6*	*8*
		%	*100.0%*	*100.0%*	*100.0%*	*100.0%*

Source: Research Data (2020)

The overall finding revealed that a majority (50.0%) of respondents confirmed that cricket farming has created other jobs like grocery, retail of poultry feeds, processing of different products, farm workers and intermediaries within value chain.

4.5 Statistical Analysis

The study employed binary logistic regression model analysis, to test the relationship or ability of the independent variable or predictors. The factors included socio-economic such as (gender, age, education, household head, marital status, religious affiliation, family size, farm enterprise income and part of income from cricket). The analysis also looked at acceptability factors which included (awareness, cultural values, perception and attitudes) and contributions of cricket farming to households food security (production level, cricket production cycles, size of cricket farming unit, cost of cricket unit construction and income from cricket) to influence dependent variable or predicted adoption which was sought by asking respondents “Do you farm cricket?”. This was in line with (Dhanai et al., 2019) study which applied binary logistic regression model to facilitate the analysis of factors influencing adoption of new farm technologies. The results are presented in the *table 17* below:

Table 17: *Analysis of Socio-Demographic Characteristics by County*

Variable	Category		N Siaya	Kisumu	Homa Bay	Total	%	Chi square	p-value
Gender	Female	no	14	8	4	26	72		
		yes	4	5	1	10	28		
	Male	no	7	9	14	30	77	2.19	0.642
		yes	0	3	6	9	23		
Age	Young	no	6	6	10	22	88		
		yes	1	2	0	3	12		
	Middle	no	14	8	6	28	70	3.595	0.077
		yes	0	5	3	8	30		
	Old	no	1	3	2	6	67		
		yes	0	1	4	5	33		
Education	No formal	no	0	0	1	1	50		
	education	yes	0	1	0	1	50		
		no	7	12	2	21	72		
	Primary	yes	0	4	4	8	28	1.200	0.351
		no	11	3	10	24	75		
	Secondary	yes	3	3	2	8	25		
		no	3	2	5	10	83		
	Post-Secondary	yes	1	0	1	2	17		
Household	Male headed	no	15	16	12	43	75		
head	Female headed	yes	4	7	3	14	25		
	Youth headed	no	5	1	3	9	64		
		yes	0	1	4	5	36	2.17	0.787
		no	1	0	3	4	100		
		yes	0	0	0	0	0		
Marital status	Single	no	1	0	3	4	67		
		yes	0	1	1	2	33		
	Married	no	15	16	11	42	76	0.364	0.989
		yes	4	6	3	13	24		
	Widow	no	5	1	4	10	71		
		yes	0	1	3	4	29		
Religious	Christian	no	21	17	16	54	74		
Affiliation		yes	4	8	7	19	26	0.697	0.407
	Others	no	0	0	2	2	1000		
		yes	0	0	0	0			
Family size	Small size (<5)	no	11	11	9	31	78		
	Middle size	yes	4	3	2	9	22		
	family (6-10)	no	9	5	8	22	76	2.309	0.503
	Large family (>	yes	0	5	2	7	24		
	10)	no	1	1	1	3	50		
		yes	0	0	3	3	50		
Farm	Low income	no	10	12	16	38	79		
enterprises	(<50,000)	yes	2	4	4	10	21		
income	Medium income	no	9	5	1	15	71		
	(51,000-100,000)	yes	1	4	1	6	29	0.900	0.358
	Upper income	no	2	0	1	3	50		
	(>100,000)	yes	1	0	2	3	50		
Part of income	None	no	20	7	17	44	88		
from crickets		yes	1	1	4	6	12		
	KES 1000-	no	0	10	1	11	58	14.236	0.000
	10,000	yes	0	7	1	8	42		
		no	0	0	0	0	0		
	KES > 10,000	yes	0	0	1	1	100		

Although findings from more women were willing to practice cricket farming, findings from *table 17* revealed that all socio-economic, Gender (p-value of 0.642), Age (p-value of 0.077), Educational background (p-value of 0.351), Household head (p-value of 0.787), Marital status (p-value of 0.989), Religious affiliation (p-value of 0.407), Family size (p-value of 0.503) input variables had no statistically associated with cricket farming apart from part of income from crickets which was observed to be at p-value (0.000 >0.05). The implication of this finding to the study is that variables such as gender, education, household head, marital status, religious affiliation, family size were not significantly related to adoption of cricket farming for improved food security.

However, further result suggested that part of income from crickets had statistically significant association with cricket farming adoption at ($p<0.000$), this demonstrated a potential motivation of income from cricket farming had towards cricket adoption. Based on the finding, farmers who set a greater profit margin tended to increase their adoption capacity. For instance, the majority (88.0%) of respondent across the three counties who did not set aside part of their income from cricket tended to discontinue with adoption while those who set aside at least between Kshs. 1000-10,000 continued with adoption. On the other hand, the study revealed that elderly people registered the highest percentage of adopters at (33.0%), while the young age category registered the lowest percentage of adopters at (12.0%).

The study further sought to investigate whether acceptability level of cricket consumption factors is related to adoption of cricket farming for improved food security. The results are presented in the *table 18* below:

Table 18: *Analysis of Acceptability level of Cricket Consumption by County*

Variable	Category		N Siaya	Kisumu	Homa Bay	Total	%	Chi square	p-value
Aware of cricket consumption as food/feed	Yes	no	21	17	18	56	75		
		yes	4	8	7	19	25	-	-
Cultural value attached to cricket consumption	No	no	18	6	8	32	86		
		yes	3	2	0	5	14	5.394	0.020
	Yes	no	3	11	10	24	63		
		yes	1	6	7	14	37		
Cultural values attached to cricket consumption	Consumed by women and children Develop good voice for singing	no	1	1	2	4	67		
		yes	0	1	1	2	33	0.038	0.848
		no	2	10	8	20	63		
		yes	1	5	6	12	37		
Crickets are good source of protein than beef.	Strongly Disagree	no	3	0	0	3	100		
		yes	0	0	0	0	0		
	Disagree	no	7	0	2	9	100		
		yes	0	0	0	0	0		
	Neutral	no	1	1	2	4	57	5.527	0.133
		yes	2	1	0	3	43		
	Agree	no	5	14	8	27	75		
		yes	0	6	3	9	25		
	Strongly Agree	no	5	2	6	13	83		
		yes	0	1	4	5	17		
Eating crickets is disgusting	Strongly Disagree	no	3	10	1	14	61		
		yes	1	6	2	9	39		
	Disagree	no	12	5	6	23	82		
		yes	1	1	3	5	18		
	Neutral	no	3	1	6	10	71		
		yes	1	1	2	4	29	4.463	0.128
	Agree	no	3	1	5	9	90		
		yes	1	0	0	1	10		
	Strongly Agree	no	0	0	0	0	-		
		yes	0	0	0	0	-		
Crickets are sweet and tender than poultry.	Strongly Disagree	no	9	0	8	17	94		
		yes	1	0	0	1	6	0.697	0.041
	Disagree	no	7	0	4	11	69		
		yes	3	0	2	5	31		
	Neutral	no	2	2	3	7	70		
		yes	0	1	2	3	30		
	Agree	no	0	0	1	1	25		
		yes	0	0	3	3	75		
	Strongly Agree	no	3	15	2	20	95		
		yes	0	7	0	1	5		
If a cricket crawls on my food then I will not eat it.	Strongly Disagree	no	5	10	5	20	69		
		yes	0	5	4	9	31		
	Disagree	no	7	3	7	17	68		
		yes	3	2	3	8	32		
	Neutral	no	2	1	1	4	80	4.351	0.055
		yes	0	1	0	1	20		
	Agree	no	2	1	1	11	92		
		yes	0	0	0	1	8		
	Strongly Agree	no	5	2	4	11	100		
		yes	1	0	0	1	0		
Eating crickets make me sick.	Strongly Disagree	no	13	12	5	30	73		
		yes	3	5	3	11	27		
	Disagree	no	7	4	7	18	75		
		yes	1	2	3	6	25		
	Neutral	no	0	1	5	6	75	0.729	0.577
		yes	0	1	1	2	25		
	Agree	no	1	0	1	2	100		
		yes	0	0	0	0	0		
	Strongly Agree	no	0	0	0	0	-		
		yes	0	0	0	0	-		

The study findings in table 18 indicated that Cultural value attached to cricket consumption and Crickets are sweet and tender than poultry were found to be significantly associated with adoption of cricket farming for improved food security ($p<0.05$). The remaining factors such as (Crickets are good source of protein than beef, eating crickets is disgusting and Eating crickets make me sick) were found to be having no any significant association with adoption of cricket farming for improved food security ($p>0.05$). The study findings suggested that Cultural value (p-value of 0.020), Crickets are sweet and tender than poultry (p-value of 0.041) and If a cricket crawls on my food then I will not eat it (p-value of 0.055) had statistical significant association with cricket farming adoption at ($p<0.05$), this demonstrated how cultural values, attitude and perception people towards cricket affects its adoption at farm level.

The study sought to investigate the acceptability level of cricket consumption by County. The findings are presented in the *table 19* below:

Table 19: *Analysis of Contributions of cricket farming to household food security by County*

Variable	Category		N Siaya	Kisumu	Homa Bay	Total	%	Chi square	p-value
What has been your production level per month?	< 5 Kgs	yes	-	7	-	7	36		
	6 – 10 Kgs	yes	4	-	2	6	32	-	-
	> 11 Kgs	yes	-	1	5	6	32		
How long is a production cycle for crickets?	< 25 days	yes	-	7	-	7	36		
	26 – 45 days	yes	4	-	2	6	32	-	-
	> 46 days	yes	-	1	5	6	32		
What is the size of your cricket farming unit?	< 0.25 acres	no	3	6	12	21	75		
		yes	0	1	6	7	25	-	-
	0.26 – 1 acre	no	9	7	4	20	80		
		yes	2	2	1	5	20		
	> 1 acre	no	9	4	2	15	68		
		yes	2	5	0	7	32		
How much did it cost you to construct the cricket unit?	< Kshs. 5,000	yes	2	5	1	8	42		
	Kshs. 5,001 – Kshs. 15,000	yes	2	1	0	3	16	-	-
	> Kshs. 15,001	yes	0	2	6	8	42		
Monthly income before adoption of cricket farming	KES. < 10,000	yes	3	6	6	15	79		
	KES. 10,001 – 20,000	yes	0	1	1	2	11	-	-
	KES. > 20,001								
		yes	1	1	0	2	10		
Monthly income after adoption of cricket farming	KES. < 10,000	yes	2	4	4	10	53		
	KES. 10,001 – 20,000	yes	2	2	1	5	26	-	-
	KES. > 20,001								
		yes	0	2	2	4	21		
% of income from cricket farming	< 25%	no	21	17	18	56	75		
		yes	4	8	7	19	25	-	-
	26% - 50%	no	0	0	0	0	0		
		yes	0	0	0	0	0		
	> 51%	no	0	0	0	0	0		
		yes	0	0	0	0	0		
Kinds of foods consumed after cricket farming	Carbohydrates	no	0	1	4	5	71		
	Carbohydrates and proteins	yes	0	0	2	2	29		
		no	4	3	2	9	82		
	Carbohydrates, proteins and Vitamins	yes	1	1	0	2	18	0.365	0.891
		no	17	13	12	42	74		
		yes	3	7	5	15	26		
Has dietary consumption pattern changed as a result of cricket farming	Yes	no	19	9	15	43	78		
		yes	3	6	3	12	22	1.347	0.249
	No	no	2	8	3	13	65		
		yes	1	2	4	7	35		
Do you think cricket farming has created any auxiliary job?	Yes	no	18	4	9	31	74		
		yes	3	7	1	11	26	0.037	0.848
	No	no	3	13	9	25	76		
		yes	1	1	6	8	24		
Do you have workers who help you manage cricket farming as an enterprise?	Yes	no	21	17	16	54	76		
		yes	4	8	5	17	24	1.359	0.247
	No	no	0	0	2	2	50		
		yes	0	0	2	2	50		

From the results in *table 19*, All variables under the contributions cricket farming has made to improved food ($p>0.05$), showed no significant association with cricket farming adoption.

Model Summary

A more detailed analysis was carried on the variables, which were found to be having significant association with the dependent variable. Based on the values of Nagelkerke R Square (0.240) and Cox & Snell R Square (0.163), the ability of the independent variable (crickets being sweeter and tender than poultry) in explaining cricket farming adoption is 24.0%. The remaining proportion was explained by other factors outside the model as shown *table 20* below. The categorical predictor variables E310a, E310b and E310e tended to exhibited lower count of strongly disagree as compared to E310c and E310d which strongly agree. Increasing level of the ordinal variables tended to positively increase level of agreement towards strongly agree in the variables. Other variables which significantly a stronger association to cricket farming are E210 and E308.

Table 20: *Analysis Summary Model*

Model Summary

Step	**-2 Log likelihood**	**Cox & Snell R Square**	**Nagelkerke R Square**
1	71.583a	.163	.240
a. Estimation terminated at iteration number 4 because maximum iterations has been reached. Final solution cannot be found.			

The overall percentage indicates that this logistic regression equation model can predict adoption of cricket farming by 73.3% as shown in table 20 below. The implication of this result to the study is that the overall success rate in classification is 71.5%.

Table 21: *Analysis Classification Table*

Classification Table[a]

Observed		Predicted		
		Do you farm cricket?		Percentage Correct
		No	yes	
Do you farm cricket?	no	47	9	83.9
	yes	11	8	42.1
Overall Percentage				73.3

a. The cut value is .500

The Variable in the Equation *table 21* below showed independent variable (part of income from cricket farming) has a P value of sig Wald test (Sig) <0.05, meaning that the variable part of income attached to cricket farming has significant positive influence on cricket farming adoption. The 2.120 model odd ratio means that part of income is 2.120 time those who decided to adopt cricket farming. This was in line with (Durst & Hanboonsong, 2015) study in Thailand, which showed that income from cricket can significantly influence farmers to adopt it as a source of livelihood.

While, (cultural value attached to cricket consumption) has a P value of Wald test (Sig) < 0.05, meaning the variable Cultural value attached to cricket consumption is insignificant positive influence on cricket farming adoption in the model. The 1.750 odds ratio means that the odds of cultural values are only 1.750 times those of the decision to adopt cricket farming This was in concurrent with (Fauscette, 2010 & Lekhanya, 2013) study which revealed that culture is a major constraint to acceptability and adoption of new farming technology such as cricket farming. 2.120

Likewise, Variable in the Equation showed that independent variable (Crickets are sweet and tender than poultry) has a P value of Wald test (Sig) < 1.062, meaning the variable crickets are sweet and tender than poultry has insignificant positive influence on cricket farming adoption in the model. The odds ratio. The 1.062 odds ratio means that the odds Crickets are sweet and tender than poultry are 0.932 times those of the decision to adopt cricket farming. Similarly, the table Variable in the Equation also indicate that a response variable (If a cricket crawls on my food then I will not eat it) has a P value of Wald test

(sig) 0.699 >0.055, meaning that the variable "if a cricket crawls on my food then I will not eat it" has insignificant positive influence on cricket farming adoption in the model. The 0.890 odds of Crickets are sweet and tender than poultry associated with the decision adopt cricket farming is 0.890 times higher for other dummy variables of adoption of cricket farming.

Table 22: *Statistical Analysis Variable in the equation*

Variables in the Equation

		B	S.E.	Wald	df	Sig.	Exp(B)	95% C.I. for EXP(B)	
								Lower	Upper
Step 1a	What is part of this income come from cricket farming? State in Kshs Classify	.751	.380	3.918	1	.048	2.120	1.007	4.460
	Do you have any cultural value attached to cricket consumption?	.559	.683	.671	1	.413	1.750	.459	6.671
	Crickets are sweet and tender than poultry.	.060	.287	.044	1	.834	1.062	.605	1.865
	If a cricket crawls on my food then I will not eat it.	-.117	.302	.150	1	.699	.890	.492	1.609
	Constant	-2.676	1.281	4.366	1	.037	.069		

a. Variable(s) entered on step 1: What is part of this income come from cricket farming? State in Kshs Classify, Do you have any cultural value attached to cricket consumption? , Crickets are sweet and tender than poultry. If a cricket crawls on my food then I will not eat it..

The logit equation then becomes;

Log (p/1-p) = - 2.676 + 0.000(210b- Part of income from crickets) + 0.5559(E308- Cultural.values) + 0.060(E310b- Crickets are sweet and tender than poultry) – 0.117(E310d- If a cricket crawls on my food then I will not eat it) as indicated in the table 22 above.

CHAPTER FIVE

SUMMARY, CONCLUSIONS AND RECOMMENDATIONS

5.0 Introduction

This chapter focus on the summary of findings, conclusions, recommendations, suggestions for further studies and contributions to the body of knowledge.

5.1 Summary of Findings

The first objective sought identify the main factors influencing adoption of cricket farming among smallholder farmers, these included, gender, age and education levels of the respondents in cricket farming. Although age, gender, education, household head, marital status, religious affiliation, family size and farm enterprises income are determinants on accepting or rejecting new technology. The overall findings showed that the majority of cricket farmers were male at 52.0% as compared to female who had 48.0%, elderly farmers of 46 years and above were observed to be more involved in cricket farming as compared to younger farmers. Majority of farmers had attained secondary education. Further findings revealed that cricket farming across the three counties was male dominant with majority of households being Christians and married.

In addition, farmers with small farm sizes and annual income above KES. 100,000 were found to be much more involved in cricket farming. The study findings also showed that the majority of farmers had not gotten any income from their cricket farming. In conclusion socio-economic determinants (age, gender, education, household head, marital status, religious affiliation, family size and farm enterprises income) were found to be having no significant association with adoption of cricket farming for improved food security (p>0.05) with only part of income from cricket farming showing significant association to adoption of cricket farming of p-value 0.000 > 0.05.

The second objective sought to determine the acceptance level of cricket consumption as an alternative source of protein among smallholder farmers, some of the predictors studied included cultural values attached to cricket consumption, perception and attitudes of consumers towards cricket consumptions as food well as awareness and availability of

cricket consumption among farmers as food. The study findings revealed that 51.0% had cultural beliefs attached to cricket consumption while 49.0% had no cultural beliefs attached to cricket consumption. This was showed in further findings, which indicated that the majority of farmers do not regard crickets as food thus; this could have influenced their attitude. The study also noted in subsequent findings whereby 50.0% reported that they have not eaten cricket because of the way it is presented while the remaining proportion of 50.0% said that crickets are unsafe to eat. The findings were in concurrent with (Ogunsumi, 2011) study, which indicated that attitude influence farmers' acceptance or rejection of a new technology, this largely depends on how the technology is presented to the farmer. Although the study finding indicated that the majority of farmers were aware of cricket farming, this did not translate into adoption of cricket farming for improve food security. This was in concurrent with (Hoek et al., 2011) study which revealed that providing information and increasing awareness alone on the environmental benefits of eating meat substitutes such as crickets is not likely to be very effective in increasing its adoption as was the case in the findings of the study. On further analysis cultural value attached to cricket consumption and crickets are sweet and tender than poultry were found to be statistically significant to adoption of cricket farming for improved food security at p-value (0.020 and 0.041) less than 0.05.

The third objective of the study sought to investigate contributions of cricket farming in food security among smallholder farmers, some of the variables under investigation included income, nutrition, food and employment. The study findings revealed that a majority of 74.7% do not farm cricket due to low income realized from cricket farming and thus attributing to lack of sustainable market to sell crickets. The findings showed that majority of farmers had not realized any change in their dietary consumption as a result of cricket farming, this could have been due to low number of farmers in active production and do not regard cricket farming as source of protein. The study also revealed that the majority of farmers were not cognizant to auxiliary job created by cricket farming, this could have been due to low production level by the few farmers who are farming crickets. On further analysis predictors such production level, size of cricket farming unit, % of income from cricket farming as well as auxiliary jobs created by

cricket farming had no association with adoption of cricket farming for improved food security (p>0.05)

5.2 Conclusion

The aim of the study was to examine determinants influencing adoption of cricket farming leading to improved food security in selected riparian communities in Siaya, Kisumu and Homa Bay Counties. The following conclusions were made based objectives drawn from both qualitative and quantitative information from the study. The first objective was to identify the main determinants influencing adoption of cricket farming among smallholder farmers in the area of study. This objective was not fully met as the study findings showed that although the majority of farmers in active production were men who were key in decision making at household level, the adoption rate for cricket farming remained low. Furthermore, majority of cricket farmers in active production were secondary school holder with small land parcels. Despite the fact that majority of cricket farmers were male at 52.0% as compared to female who had 48.0%, the adoption rate among farmers still remained low with majority of farmers being elderly people of 46 years and above. Although the findings revealed that the majority of households had attained secondary education, male headed, married and key decision makers, the adoption of cricket farming remained very low among farmers. In addition, farmers with small farm sizes and annual income above KES. 100,000 were found to be much more involved in cricket farming. The study concluded that determinants such as age, gender, education, household head, marital status, religious affiliation, family size and farm enterprises income had no association with adoption of cricket farming with only variable part of income from cricket having significant statistical association to cricket farming adoption.

The second objective was to determine the acceptance level of cricket consumption as an alternative source of protein among smallholder farmers in Siaya, Kisumu and Homa Bay. The study findings concluded that cultural beliefs attached to cricket consumption had influence on adoption of cricket farming. For instance, 50.0% of the respondents reported that they have not eaten cricket because of the way it is presented while the

remaining proportion of 50.0% said that crickets are unsafe to eat. Some of the predictors analyzed included cultural values attached to cricket consumption, crickets are sweet and tender than poultry and if a cricket crawls on my food then I will not eat it, which were found to be having significantly association with adoption of cricket farming for improved food security. Although the study findings indicated that the majority of farmers were aware of cricket farming, this did not translate into adoption of cricket farming for improve food security. However, cultural value attached to cricket consumption, crickets are sweet and tender than poultry as well as if cricket crawl in my food I will not eat had significant association to adoption of cricket farming. Similar findings were also obtained from extension workers through key informant interviews farmer groups through focus group discussions.

The third objective was to investigate the contribution of cricket farming in food security among smallholder farmers in the study area. The study findings revealed that a majority of 74.7% do not farm cricket due to low income realized from cricket farming and thus attributing to lack of sustainable market to sell crickets. Majority of farmers had not realized any change in their dietary consumption as a result of cricket farming consequently the majority of farmers were not cognizant to auxiliary job created by cricket farming. The study findings concluded that production level, size of cricket farming unit, auxiliary jobs created by cricket farming had no association with adoption to cricket farming for improved food security.

Although cricket farming at smallholder farmers is one effort towards sustainable rural food production, more needs to be done to understand which systems could be used to make farmed insects more profitable to smallholder farmers.

5.3 Recommendations

The study makes the following recommendations:

1. There is need for a further study to determine possible strategies for changing perception, stereotypes and prejudices towards cricket farming, and consumption for increased adoption by smallholder farmers in the Kenyan Victoria Basin.
2. A study to understand health safety of crickets' utilization as food and feed for improved food security in riparian of Lake Victoria Basin.
3. The study recommends further study to understand the relationship between gender, education and awareness and adoption of cricket farming for improved food security.
4. There is need to further study on policies which if established would enhance insect farming and consumption as a mini-livestock and consequently guide development of edible insect-based curriculum for learning institutions that will facilitate training of extension workers and stakeholders on cricket production.
5. There is need for further research on commercialization of insect-based products by agro-processors on cricket farming in Kenya.
6. The study recommends sensitization workshops for stakeholders on cricket farming for improved food security in the Lake Victoria Basin.

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ANNEXES

Annex 1. Ethical Review Research Approval Letter

JARAMOGI OGINGA ODINGA
UNIVERSITY OF SCIENCE AND TECHNOLOGY
DIVISION OF RESEARCH, INNOVATION AND OUTREACH
JOOUST-ETHICS REVIEW OFFICE

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P.O. BOX 210 - 40601
BONDO

30th January, 2020

OUR REF: JOOUST/DVC-RIO/ERC/E2

Oyaro Hagai Ong'echa
SAFS
JOOUST

Dear Mr. Ong'echa,

RE: APPROVAL TO CONDUCT RESEARCH TITLED "FACTORS INFLUENCING ADOPTION OF CRICKET FARMING (ACHETA DOMESTICUS) AMONG FARMERS FOR IMPROVED FOOD SECURITY IN RAPERIAN COMUNITIES IN KENYAN VICTORIAN BASIN"

This is to inform you that JOOUST ERC has reviewed and approved your above research proposal. Your application approval number is **7/16/ERC/01/20-05.** The approval period is from 29th January, 2020 – 28th January, 2021.

This approval is subject to compliance with the following requirements:

i. Only approved documents including (informed consents, study instruments, MTA) will be used.
ii. All changes including (amendments, deviations and violations) are submitted for review and approval by JOOUST IERC.
iii. Death and life threatening problems and serious adverse events or unexpected adverse events whether related or unrelated to the study must be reported to NACOSTI IERC within 72 hours of notification.
iv. Any changes, anticipated or otherwise that may increase the risks of affected safety or welfare of study participants and others or affect the integrity of the research must be reported to NACOSTI IERC within 72 hours.
v. Clearance for export of biological specimens must be obtained from relevant institutions.
vi. Submission of a request for renewal of approval at least 60 days prior to expiry of the approval period. Attach a comprehensive progress report to support the renewal.
vii. Submission of an executive summary report within 90 days upon completion of the study to JOOUST IERC.

Prior to commencing your study, you will be expected to obtain a research permit from National Commission for Science, Technology and Innovation (NACOSTI) https:oris.nacosti.go.ke and also obtain other clearances needed.

Yours sincerely,

Prof. Francis Aiga'wa
Chairman, JOOUST ERC
Copy to: Deputy Vice-Chancellor, RIO Director, BPS Dean, SAFS

Annex 2. Research License from NACOSTI

REPUBLIC OF KENYA

NATIONAL COMMISSION FOR SCIENCE, TECHNOLOGY & INNOVATION

Ref No: 239022

Date of Issue: 12/June/2020

RESEARCH LICENSE

This is to Certify that Mr.. Ongicha Hagai Oyaro of Jaramogi Oginga Odinga University of Science and Technology, has been licensed to conduct research in Homabay, Kisumu, Siaya on the topic: FACTORS INFLUENCING ADOPTION OF CRICKET FARMING (Acheta domesticus) AMONG FARMERS FOR IMPROVED FOOD SECURITY IN RAPERIAN COMMUNITIES IN KENYAN VICTORIA BASIN for the period ending : 12/June/2021.

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239022

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2. The License any rights thereunder are non-transferable
3. The Licensee shall inform the relevant County Director of Education, County Commissioner and County Governor before commencement of the research
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Annex 3. Data Collection Approval letter from Kisumu Sub-County

REPUBLIC OF KENYA

COUNTY GOVERNMENT OF KISUMU
County Department of Agriculture,Livestoch & Fisheries

Telephone: 057 - 2024887,
Telkom Wireless: 020-2030842
Email: daokisumueast@yahoo.com
When replying please quote
Ref.MOA/KSM EST/GC/DC/E7/VOL. IV (157)

Sub County Agricultural Office
Kisumu East
P O Box 1958
KISUMU

9th June 2020

TO WHOM IT MAY CONCERN

RE: FIELD DATA COLLECTION BY MR.ONGECHA HAGAI OYARO, ID NUMBER 11671482.

This is to inform you that the above mentioned person is a student of Jaramogi Oginga Odinga University of Science and Technology, currently pursuing Master of Science degree in Food Security and sustainable Agriculture.

He is currently collecting data for his thesis titled ‚Determinants for Adoption of Cricket farming by smallholders in Kisumu East and Kisumu Central Sub Counties.

Kindly accord him the necessary support that may facilitate this research..

Yours sincerely

SUB-COUNTY AGRICULTURAL OFFICE
KISUMU EAST
P.O BOX 1958 KISUMU
DATE... 9th June 2020

Thomas Ezron Oganda
Agribusiness Officer
For.Sub County Agricultural Officer
KISUMU EAST SUB COUNTY.

Annex 4. Data Collection Approval Letter from Kisumu County

REPUBLIC OF KENYA

COUNTY GOVERNMENT OF KISUMU

Department of Agriculture, Irrigation, Livestock and Fisheries

Office of the Chief Officer – Agriculture and Irrigation

Telephone: 020-2047148
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When replying please quote:
Ref: MALF/COALF/-KSM/GC/EDUC.1/VOL.11/224

Prosperity House
11th Floor, Wing 'C'
P.O. Box 1700-40100
KISUMU
Date:9th June, 2020

TO WHOM IT MAY CONCERN:

RE: APPROVAL FOR FIELD DATA COLLECTION BY MR. ONGECHA HAGAI OYARO ID NUMBER -11671482.

The above matter refers.

This is to inform your office that the above mentioned person is a student of Jaramogo Oginga Odinga University Science and Technology (JOOUST), currently pursuing Master of Science degree in Food Security and Sustainable Agriculture.

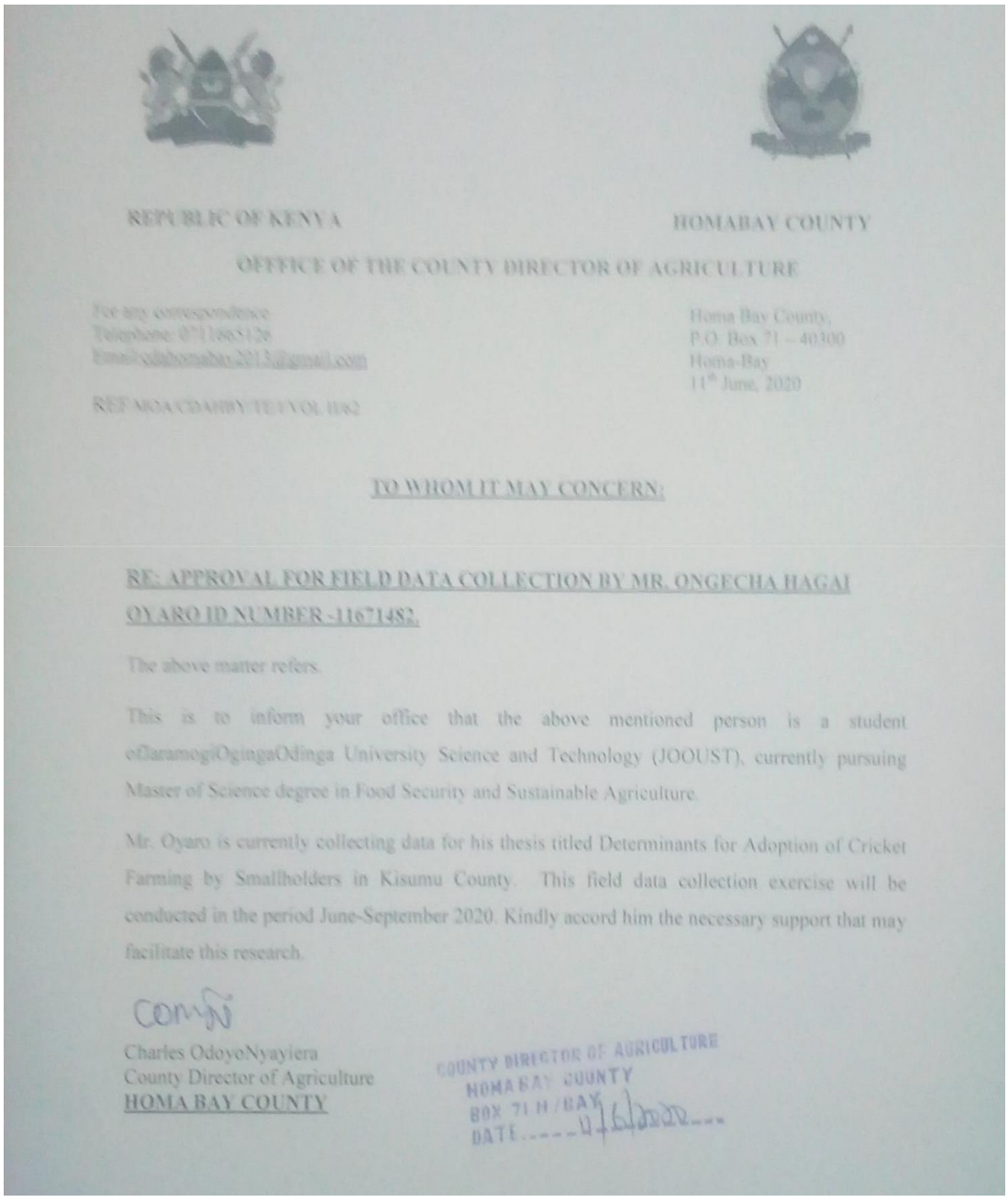
Mr. Oyaro is currently collecting data for his thesis titled Determinants for Adoption of Cricket Farming by Smallholders in Kisumu County. This field data collection exercise will be conducted in the period June-September 2020.

Kindly accord him the necessary support that may facilitate this research.

Thank you

Dr. Paul Omanga
Chief Officer
Agriculture and Irrigation
KISUMU

Annex 5. Data Collection Approval Letter from Homa Bay County



REPUBLIC OF KENYA

HOMABAY COUNTY

OFFICE OF THE COUNTY DIRECTOR OF AGRICULTURE

For any correspondence
Telephone: 0711865126
Email: cdahomabay2013@gmail.com

Homa Bay County,
P.O. Box 71 – 40300
Homa-Bay
11th June, 2020

REF MOA/CDAHBY/TECH/VOL II/62

TO WHOM IT MAY CONCERN:

RE: APPROVAL FOR FIELD DATA COLLECTION BY MR. ONGECHA HAGAI OYARO ID NUMBER -11671482.

The above matter refers.

This is to inform your office that the above mentioned person is a student ofJaramogiOgingaOdinga University Science and Technology (JOOUST), currently pursuing Master of Science degree in Food Security and Sustainable Agriculture.

Mr. Oyaro is currently collecting data for his thesis titled Determinants for Adoption of Cricket Farming by Smallholders in Kisumu County. This field data collection exercise will be conducted in the period June-September 2020. Kindly accord him the necessary support that may facilitate this research.

Charles OdoyoNyayiera
County Director of Agriculture
HOMA BAY COUNTY

COUNTY DIRECTOR OF AGRICULTURE
HOMA BAY COUNTY
BOX 71 H/BAY
DATE.....

Annex 6. Research Data Collection Tool

STRUCTURED INDIVIDUAL INTERVIEW

DATA COLLECTION INSTRUMENT

Preamble

Hello. My name is _____. I am a student from Jaramogi Oginga Odinga University of Science and Technology undertaking Ms. in Food Security and Sustainable Agriculture. In order to get information on factors influencing adoption of cricket rearing among smallholder farmers, am conducting a research in Siaya, Kisumu and Homa Bay Counties. Your household has been selected being one the farmers who participated in cricket rearing training or and in active production of crickets. I would like to ask you some questions related to factors influencing adoption of cricket farming, level of acceptability of cricket consumption as well as the contributions cricket farming has made to your household in terms of food security.

The information you provide in this research will not only be useful in finding out factors influencing adoption of cricket farming but will also help in proposing effective strategies that would enhance cricket farming for improved food security.

Participation in this survey is voluntary, and you can choose take part or not to take part.

All the information that you provide during this study will be confidential. And will only be used for the purpose of thesis writing.

Respondent consent and agreement to be interviewed.

I do here by agreed to be interviewed

Signature and Date

SECTION 1: HOUSEHOLD IDENTIFICATION

This section is to be completed for each household visited.
Enumerator ID._____

County *(drop down)*
- Siaya
- Kisumu
- Homa Bay

Sub-County Name *(drop down)*

Siaya	**Homa Bay**	**Kisumu**
○ Bondo	○ Homa Bay Town	○ Kisumu Central
○ Ugenya	○ Kabondo Kasipul	○ Kisumu East
○ Ugunja	○ Rangwe	○ Kisumu West
○ Alego	○ Mbita	○ Seme
○ Gem	○ Suba	○ Nyando
○ Rarieda	○ Ndhiwa	○ Muhoroni
	○ Karachuonyo	○ Nyakach

Respondent's Name: _____

Take GPS
Latitude (x.y°)
_____
Longitude (x.y°)
_____
Altitude (m)
_____
Accuracy (m)
_____

Interviewer Number: _____

SECTION 2: SOCIO-ECONOMIC PROFILE

E200. Gender:

|_____|

1. Male
2. Female
3. None

E201. Age: - State the age (years) ---------- Classify

1. Young < 35
2. Middle age 36 – 60
3. Old > 60

E202. Highest level of education attained:

|_____|

1. No formal education
2. Primary
3. Secondary
4. Post-Secondary

E203. Household head:

|_____|

1. Male headed
2. Female headed
3. Youth headed

E204. Marital status:

|_____|

1. Single
2. Married
3. Widow

E205. What is your religion affiliation?

|_____|

1. Christian
2. Muslim
3. Others

E206. Family size: - State the number of your family members ----------

Classify

1. Small size family (< 5)
2. Middle size family (6 -10)
3. Large family (> 10 persons)

E207. Farm size: - State size of your farm in acres ----------

Classify

1. < 1 acres
2. 1 – 2acres
3. > 3 acres

E208. What are your sources of livelihood? *(Multiple choices)*

1. Employment
2. Business
3. Livestock farming
4. Crop farming
5. Fishing

E209. Of the choices you have selected in *(Q E208)*, what is your **MAIN** source of livelihood? |_____|

1. Employment
2. Business
3. Livestock farming
4. Crop farming
5. Fishing

E210. State estimated total annual income from your farm enterprises in Kshs ----------

Classify

1. Low income (< 50,000)
2. Medium Income (51,000-100000)
3. Upper income (>100, 000)

E210. What is part of this income come from cricket farming? State in Kshs----------

Classify

1. None

2. Kshs. 1 – Kshs. 10,000
3. < Kshs. 10,001

E211. What is the family's **MAIN** area of expenditure?

|_____|

1. Food
2. Education
3. Health
4. Others (specify) ----------

E 212. In order priority, which area is your income from cricket farming spent on?

1. Food
2. Education
3. Health
4. None

3: ACCEPTABILITY LEVEL OF CRICKET CONSUMPTION

E301. Are you aware of cricket consumption as food or feed?

|_____|

1. Yes
2. No *(Skip to E310)*

E302. If yes in *(Q E301)*, have you ever eaten cricket?

|_____|

1. Yes
2. No *(Skip to E307)*

E303. If yes where did you eat crickets?

1. House
2. Hotel
3. Seminar

E304. How frequently do you eat crickets in a month?

|_____|

1. Once
2. Two times
3. More than three times

E305. How available are cricket for ease of access by your household?

1. Readily available
2. Not available

E306. Where do you access crickets for your household consumption?

|_____|

1. Own farm
2. Market
3. Neighbours
4. Wild

E307. If no in *(QE302),* what prevent you from eating cricket as food?

1. Cricket eating is ancient and primitive practice
2. Crickets are unsafe to eat
3. Presentation status

E308. Do you have any cultural value attached to cricket consumption? |_____|

1. Yes
2. No

E309. If yes in *(QE308)* which of the **two** are attached to cricket consumption?

1. Cricket consumption makes people develop good voice for singing
2. Crickets are only consumed by women and children
3. Others (specify)----------

E310. What is your degree of agreement on each of the following sentences (choose from "1=strongly disagree to 5=strongly agree")

No.	Indicators	1-Stronly Disagree	2-Disagree	3-Neutral	4-Agree	5-Strongly Agree
1.	Crickets are good source of protein than beef.					
2.	Eating crickets is disgusting					
3.	Crickets are sweet and tender than poultry.					
4.	If a cricket crawls on my food then I will not eat it.					
5.	Eating crickets make me sick.					

SECTION 4: CONRIBUTION OF CRICKET TO LIVELIHOODS

Contribution to Income

E401. Do you farm cricket?

|_____|

1. Yes
2. No *(Skip to E424)*

E402. If yes where did you learn about it?

|_____|

1. Seminar
2. Extension Officer
3. Others specify----------

E403. When did you start cricket farming? State the year ----------

Classify

1. < 2 years
2. 3 – 4 years
3. > 4 years ago

E404. How frequently do you sell your cricket?

|_____|

1. Every month
2. Twice a month
3. More than thrice a month

E405. What has been your production level per month? State in Kgs ----------

Classify

1. < 5 Kgs
2. 6 – 10 Kgs
3. > 11 Kgs

E406. What amount of crickets do you produce per production cycle? State in Kgs---------

Classify

1. < 25 Kgs
2. 26 –100 Kgs
3. 100 Kgs

E407. How many production cycles do you have in a year? State ----------

Classify

1. < 1 cycle
2. 2 – 3 cycle
3. > 4 cycle

E 408. How long is a production cycle for crickets? State days ----------

Classify

1. < 25 days
2. 26 – 45 days
3. > 46 days

E410. How do you cost cricket value added products you have selected in *(QE408)*?

1. Drying: State in Kshs. ----------
2. Process to Powder: State in Kshs. ----------
3. Making bread, biscuits and cookies: State in Kshs. ----------

E411. What is the size of your cricket farming unit?

1. < 0.25 acres
2. 0.26 – 1 acre
3. > 1 acre

E412. Which production systems do you use for cricket farming?

1. Wooden Cage System
2. Plastic or Buckets System
3. Concrete Pen System
4. Others please specify ----------

E413. How much did it cost you to construct the cricket unit? State figures in Kshs. -------

Classify

1. < Kshs. 5,000
2. Kshs. 5,001 – Kshs. 15,000
3. > Kshs. 15,001

E414. Which type of feeds do you use to feed your crickets?

1. Commercial feeds
2. Local feeds

E415. If commercial feeds in *(Q 413)*, how much do you spent on acquisition of feeds per production cycle? State figure in Kshs. ----------

Classify

1. < Kshs. 2,500
2. Kshs. 2,501 – Kshs. 5,000
3. > Kshs. 5,001

E416. How much do you spent in training workers and yourself on how to farm crickets per production cycle? State figure in Kshs. ----------

Classify

1. < Kshs. 5,000
2. Kshs. 5,000 – Kshs. 10,000
3. > Kshs. 10,001

E417. How much do you spent on labour per production cycle? State figures in Kshs. ----

Classify

1. < Kshs. 10,000
2. Kshs. 10,001 – Kshs. 20,000
3. > Kshs. 20,001

E418. How much do you spent on transport of cricket to the marketing per production cycle? State figures in Kshs. ----------

Classify

1. < Kshs. 2,500
2. Kshs. 2,501 – Kshs. 5,000
3. > Kshs. 5,001

E419. How much do you spent on value addition and other hygiene practices per production cycle? State figures in Kshs. ----------

Classify

1. < Kshs. 3,000
2. Kshs. 3,000 – Kshs. 6,000

3. > Kshs. 6,001

E420. Where do you sell your crickets?

|_____|

1. Middle men
2. Transporters
3. Consumers

E421. What was your monthly income before adoption of cricket farming? State the amount Kshs ----------

Classify

1. < Kshs. 10,000
2. Kshs. 10,001 – 20,000
3. > Kshs. 20,001

E422. What is your current monthly income after adoption of cricket farming? State amount in Kshs ----------

Classify

1. < Kshs. 10,000
2. Kshs. 10,001 – 20,000
3. > Kshs. 20,001

E423. What percentage of the income have you realized as a result of cricket farming? State -----

1. < 25%
2. 26% - 50%
3. > 51%

E424. If no in *(QE401)*, why?

1. Due to inadequate funds
2. Lack of interest to rear crickets
3. Due to insufficient skills to rear crickets

E425. Where do you access your crickets from? |_____|

1. Fellow farmers

2. Market
3. Wild source

E426. How do you perceive cricket farming?

|_____|

1. Good enterprise
2. Not a good enterprise

E427. If not a good enterprise in *(Q426),* please give reason for your answer?

1. Cricket farming is too involving
2. Lack of market for mature crickets
3. High cases of death resulting from diseases.

E428. Are crickets available in your local markets?

|_____|

1. Yes
2. No *(Skip to E430)*

E429. If yes, how much is a kilo of cricket? State the amount in Kshs ----------

Classify

1. < Kshs. 20
2. Kshs. 21 – Kshs. 40
3. > Kshs. 41

E430. If no in *(QE428),* then who are the main suppliers of cricket? |_____|

1. Farmers

Middlemen

2. Organizations / Institutions

E431. How frequently do you buy crickets in a month?

|_____|

1. Once
2. Twice
3. Thrice

Contribution to Nutrition and Food

E432. If yes in *(Q401),* how many meals were you able to take per day before adoption of cricket rearing? |____|

1. One meal per day
2. Two meals per day
3. Three meals per day

E433. How many meals are you able to take per day after adoption of cricket rearing? |_____|

1. One
2. Two
3. Three

E434. How many kinds of foods were you consuming before cricket farming? |_____|

1. Carbohydrates, Protein, Vitamins, Minerals and Water
2. Carbohydrates, Vitamins, Minerals and Water
3. Carbohydrates, Protein and Water

E435. How many kinds of foods are you able to consume after cricket farming? |_____|

1. Carbohydrates
2. Carbohydrates and Proteins
3. Carbohydrates, proteins and Vitamins

E436. Do you think your dietary consumption pattern has changed as a result of cricket farming? |_____|

1. Yes
2. No

E437. If yes please explain? ----------

E438. Were you able to make any personal development before adoption of cricket farming?

1. Yes
2. No

E439. If yes, which ones? State for example:

1. Mobile Phone / Radio
2. Land
3. Others please specify ----------

E440. Which type of development or investment have you been able to acquire after adoption of cricket farming?

|_____|

1. Consumable goods (TV, Radio, Music systems, Mobile phone).
2. Construction of modern shelter (Permanent house/Semi-permanent house);
3. Household furniture's (Chairs, utensils) and Land
4. Others specify ----------

E441. Which social concerns have you been able to care for since you adopted cricket farming?

1. Medical expenses
2. School fees
3. Others specify ----------

Contribution to employment creation

E442. Do you think cricket farming has created any auxiliary job?

|_____|

1. Yes
2. No

E443. If yes in *(QE412)* which ones? |_____|

1. Boda Boda transport
2. Carpentry/Masonry
3. Others please specify ----------

E444. Do you have workers who help you manage cricket farming as an enterprise? |_____|

1. Yes
2. No

E445. If yes in *(QE444)* which type of labour?

|_____|

1. Hired Labour / Casual Labour
2. Permanent Labour

E446. Please specify how many are hired and how many are permanent?

1. Hired Labour / Casual Labour ----------
2. Permanent Labour ----------

THE END

Thank the respondent and proceed to the next respondents

Annex 7. Key Informant Interview

KEY INFORMANT INTERVIEWS
QUESTION CHECK LIST GUIDE

Preamble

Hello. My name is _____. I am a student from Jaramogi Oginga Odinga University of Science and Technology undertaking Msc. in Food Security and Sustainable Agriculture. In order to get information on factors influencing adoption of cricket rearing among smallholder farmers, am conducting a research in Siaya, Kisumu and Homa Bay Counties. You have been selected to participate in this research being one of the technical staff working with farmers in this County. I would like to ask you some questions with regards to adoption of cricket farming, its acceptability for consumption as well as its contributions to household in terms of food security.

The information you provide in this study will be useful in finding out factors influencing adoption of cricket farming and in proposing strategies that would effective in enhancing cricket farming for improved food security.

Participation in this survey is voluntary, and you can choose take part or not.

All the information that you provide during this study will be confidential. And will only be used for the purpose of thesis writing.

Informed consent

Respondent agreed to be interviewed	**1.** YES **2.** NO

Signature of interviewer: _____

Date: _____

1. Which main socio-economic factors influence adoption of cricket farming among smallholder farmers in the County? (Probe for education, age and gender).
2. How has those factors mentioned in *(Question 1)* influence adoption of cricket farming?
3. What do you think could be done to increase rate of adoption among cricket farmers?
4. Are people aware of cricket / cricket products consumption as alternative source of food or feed?
5. If yes in *(Question 4),* where do household obtain the crickets or cricket products for consumption?
6. If no in (*Question 4),* what could be the barriers to awareness of crickets / cricket product consumption as alternative source of food or feed?
7. Do you think farmers in the County consume cricket as alternative source of protein (Food or feed)? If no, why?
8. On a scale of ***1- 5,*** how would you rate the level of cricket consumption among smallholder farmers in the County, what inform your rating?
9. If yes in *(Question 7),* what would you say influenced the consumption of crickets or cricket products? How do people perceive cricket consumption in the County? (Probe for how much do people pay for the crickets or their products)
10. What do you think could be done to increase the consumption of cricket as alternative source of protein in the County?
11. How has cricket farming contributed to improved food security among smallholder farmers in the County? (Probe for income, food and employment)
12. What are the major sources of local protein in the County?
13. What is the monthly average cricket production?
14. How much income do farmers generate from cricket sales per month?
15. Are there people employed within the cricket farming value chain? If yes at what point of the value chain are they employed? i.e. production, transporters etc.
16. Do you think it is important to introduce insect as food and feed? (Please explain your response)
17. What innovative methods would you prefer for promoting insect as food and feed?

18. In your view, what are the major challenges to the current methods being used by farmers?
19. Whom do you think should be targeted for a successful promotion of insects as food and feed?
20. Is there any support the government has extended to cricket farmers towards improving food security? If yes which once?
21. If no in *(Question 20),* where do farmers get extension services for cricket rearing? And what would be your suggestion?
22. Who are the major cricket producers in the County? Who are the major suppliers for cricket farming inputs?
23. Where do cricket producers sell their Cricket?
24. What do you think need to be done differently to increase adoption of cricket farming?

THE END

Thank the respondents and proceed to the next group

Annex 8. Focus Group Discussion

FOCUS GROUP DISCUSSION GUIDE

DATA COLLECTION INSTRUMENT

Preamble:

Hello. My name is _____. I am a student from Jaramogi Oginga Odinga University of Science and Technology undertaking Msc. in Food Security and Sustainable Agriculture. In order to get information on factors influencing adoption of cricket rearing among smallholder farmers, am conducting a research in Siaya, Kisumu and Homa Bay Counties. You have been selected to participate in this research being one of the technical staff working with farmers in this County. I would like to ask you some questions with regards to adoption of cricket farming, its acceptability for consumption as well as its contributions to household in terms of food security.

The information you provide in this study will be useful in finding out factors influencing adoption of cricket farming and in proposing strategies that would effective in enhancing cricket farming for improved food security.

Participation in this survey is voluntary, and you can choose take part or not.

All the information that you provide during this study will be confidential. And will only be used for the purpose of thesis writing.

Consent

_____

Respondent agreed to be interviewed

3. YES

4. NO

Signature and date ----------

1. Do you rear crickets? If yes what influenced you to start rearing crickets? (Probe for market, income)
2. If yes in (*Question 1)*, which contributions has cricket farming made to your lives as farmers? Please explain your response (Probe for income, food and employment)
3. If no in (*Question 1)*, what has barred you from adopting cricket rearing? (Probe for market, training, cultural beliefs)
4. What is your local source of protein?
5. Do you think farmers consider cricket as alternative source of protein (Food or feed)? If no, why?
6. On a scale of *1- 5*, how would you rate the level of cricket consumption among smallholder farmers, what inform your rating?
7. What would you say influence the consumption of crickets or cricket products? How do people perceive it? (Probe for how much do people pay for the crickets or their products).
8. What do you think could be done to increase the consumption level of cricket as alternative source of protein? What is your opinion on introducing insect as alternative sources of protein for food and feed? (Please explain your response?)
9. How many days does your production cycle take? (Probe in days)Lack of proper training on feeding process and number of days per cycle.

Poor extension services. Unknowledgeable extension workers

10. How much do you spent on cricket farming per production cycle Kshs? (Probe from unit construction to harvesting)?
11. How many kilograms of crickets do normally produce on average per production cycle (Kgs)? And how much income do farmers generate from cricket sales?
12. Which type of auxiliary jobs has cricket farming created within the cricket value chain?
13. Which type of development or investment have you been able to acquire after adoption of cricket farming?
14. Which social concerns have you been able to care for since you adopted cricket farming?
15. What are some of the reasons why you have not used the skills?

16. What do you think could be the most innovative methods of promoting insect as food and feed?
17. Have you been trained? If yes who trained you?
18. What are your main sources of information for cricket farming?
19. Who should be targeted for a successful promotion of insects as food and feed? (Men, women or youth)
20. What else do you think could be done to increase adoption of cricket farming among farmers?

THE END

Thank the respondent and proceed to the next respondents