CHALLENGES FACING INDIGENOUS CHICKEN PRODUCTION AND ADOPTION LEVELS OF BIOSECURITY MEASURES IN SELECTED AREAS OF MAKUENI COUNTY, KENYA

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A Thesis submitted in Partial Fulfilment of the Requirements for the Degree of Master of Science in Agricultural Resource Management of South Eastern Kenya University

2018

DECLARATION

I understand that plagiarism is an offence and I therefore declare that this thesis is my original work and has not been submitted to any other institution for any other award.

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ACKNOWLEDGEMENT

I wish to express my heartfelt gratitude to all those who have willingly rendered a helping hand in preparing this thesis. First; to my supervisors, Dr Aphaxard J.N.Ndathi and Dr Eric O. Mungube, whose advice, patience and continued support aided in the progress and eventual successful completion of this thesis, their very busy schedules notwithstanding. Secondly, my sincere gratitude and appreciation go to my family for their patience, prayers and material support that enabled me to complete this thesis. My data collection team, Mr Justus Ngesu, Mr. Julius Kinywee, Mr. Joseph Lonzi, James Mbithuka of department of Agriculture, Isaac Kitonga and Julius Mutunga of department of livestock- Makueni County, Festus Kisilu of Egerton university, Fabian Munyao and Nicholus Mulu of Kikima Dairy farmers cooperative Society.

Special mention goes to my statistician Mr. Eli Mutaaru, who without reservation supported me in data cleaning, entry, analysis and compilation of the study findings. Lastly, the farmers for participating in the survey and chiefs of Muvau, Kikumini, Kitundu and Kithungo locations for assistance in awareness creation on my study and mobilization of the households survey respondents and focussed group participants. Any other individuals not mentioned above and who in one way or another helped in the success of this study and subsequent development of this thesis, let them feel thanked and may God profoundly reward them all. I acknowledge the greatness of the almighty God for enabling me complete this thesis.

DEDICATION

This work is dedicated to my dear wife Eunice for her support and patience during my studies and to my immediate supervisor at my work station Mr David M. Musyoki, (County Director of Livestock and Veterinary Services-Makueni County) for financial, material and moral support during my studies.

TABLE OF CONTENTS

DECLARATION ii

ACKNOWLEDGEMENT iii

DEDICATION iv

TABLE OF CONTENTS v

LIST OF TABLES xi

LIST OF PLATES xiii

LIST OF FIGURES xiv

ABBREVIATIONS AND ACRONYMS xv

DEFINITION OF TERMS xvii

ABSTRACT xviii

CHAPTER ONE 1

1.0 Introduction 1

1.1 Background of the Study 1

1.2 Problem Statement 5

1.3 Objectives of the study 5

1.3.1 General Objective 5

1.3.2 Specific Objectives 5

1.4 Research questions 5

1.5 Justification of the study 6

1.6 Theoretical framework 7

1.7 Limitation.....7
1.8 Scope.....8
1.9 Assumptions.....8
CHAPTER TWO 9
2.0 LITERATURE REVIEW 9
2.1 Introduction.....9
2.1.1 Importance of livestock to human welfare..... 9
2.2 Status of the global poultry sector 10
2.3 Status of poultry production in Kenya 11
2.4 Poultry in smallholder production systems.....12
2.5 Scavenge based poultry production systems and their challenges.....13
2.6 Constraints in chicken production 14
2.6.1 Production constraints 15
2.6.2 Socio -economic constraints..... 17
2.6.3 Socio-cultural constraints 18
2.6.4 Infrastructural, institutional and technical constraints..... 19
2.7 Biosecurity measures 19
2.7.1 Introduction 19
2.7.2 Biosecurity in indigenous chicken production 20
2.7.2.1 Definition..... 20
2.7.3 Status of Biosecurity in Poultry production..... 20

2.7.4 Advantages of maintaining biosecurity measures at the farm 21

2.8 Constraints facing adoption of biosecurity measures 22

2.9 The conceptual framework 23

CHAPTER THREE 25

3.0 METHODOLOGY 25

3.1 Study area..... 25

3.1.1 Background Information of Makueni County 25

3.1.2 Climatic condition..... 29

3.1.3 Agriculture 29

3.1.4 Livelihood zones.....31

3.1.5 Selected Study site 31

3.1.6 Study sites selection procedure.....31

3.2 House hold sample size determination 34

3.3 Sampling design..... 35

3.4 Data collection 35

3.4.1 Primary data..... 35

3.4.1.1 Focused group discussion..... 35

3.4.1.2 Household survey 36

3.5 Data Analysis and presentation.....36

CHAPTER FOUR.....38

4.0 RESULTS 38

4.1 Results of house hold survey 38
4.1.1 Response Rate..... 38
4.1.2 Household Background Information 38
4.1.3 Livestock and Poultry..... 41
4.1.4 Breeds of Livestock kept 42
4.1.5 Flock structure of chicken kept 42
4.1.6 Reasons for keeping Indigenous chicken 43
4.1.7 Method of raising chicken 44
4.1.8 Challenges faced when rearing indigenous chicken..... 45
4.1.9 Management of Chicken Diseases..... 48
4.1.10 Training on Chicken Management 49
4.1.11 Extension Services for chicken Production 51
4.1.12 Suggested solutions to the identified challenges..... 53
4.1.13 Provision of supplementary feeds to indigenous chicken..... 55
4.1.14 Effects of indigenous chicken rearing constraints on productivity..... 58
4.2 Biosecurity Measures.....58
4.2.1 Type of chicken housing structure..... 58
4.2.2 Safety of feeds and frequency of cleaning feeding and drinking equipment . 64
4.2.3 Sources of breeding stock..... 66

4.2.4: Mode of transporting breeding stock from the source to the farm..... 66

4.2.5 Animals that chicken flocks interacted with on the farm 69

4.2.6 Biosecurity measures in the farms..... 70

4.3 Socio-Economic and Ecological hindrance the adoption of Biosecurity measures.71

4.3.1 Ownership of Indigenous Chicken 71

4.3.2 Labour provision for chicken management..... 73

4.3.3 Diseases and pests control strategies used by the farmers..... 74

4.3.4 Channels used in marketing of chickens 78

4.3.5 Effect of environment on chicken productivity..... 79

4.3.6 Future Trends in Indigenous Chicken farming..... 79

4.4 Main constraints in chicken production in Kikumini/Muvau ward.....80

4.5 Biosecurity issues in chicken production.....83

4.6 Marketing of chicken and prices at farm gate and at the market centre……83

CHAPTER FIVE 86

5.0 DISCUSSION.....86

5.1 Introduction.....86

5.2 Constraints that affects the productivity of indigenous chicken.....86

5.3 Biosecurity Measures.....90

5.4 Socio-Economic and Ecological hinderance to Adoption of Biosecurity Measures92

CHAPTER SIX.....94

6.0 Conclusions and recommendations.....94

6.1 Conclusions.....94
6.2 Recommendations.....95
6.3 Suggestion for further studies.....95
REFERENCES.....96
APPENDICES.....107
APPENDIX I: FARMERS QUESTIONNAIRE.....107
APPENDIX II: FOCUS GROUP DISCUSSION CHECK LIST.....116
APPENDIX III: CERTIFICATE OF PUBLISHING IN IJAR.....134
APPENDIX IV: PUBLISHED PAPER IN IJAR.....135

LIST OF TABLES **Page**

Table 1.1 Livestock population trend in Makueni County 2010-2015……3

Table 3.1 Administrative and elective units and their population…….26

Table 4.1 Position of respondent in the household……38

Table 4.2 Head of household…….....39

Table 4.3 Respondent occupation…….....40

Table 4.4 Average number of livestock per HH by study ward……42

Table 4.5 Classes of chicken kept…….....43

Table 4.6 Challenges faced while rearing IC production in both wards……45

Table 4.7 χ^2 Statistics on challenges facing IC production……47

Table 4.8 Management of chicken diseases…….....48

Table 4.9 Cross tabulation between HH members trained and how they benefited……..50

Table 4.10 Extension services on chicken production…….....52

Table 4.11 Challenges to receiving extension services……53

Table 4.12 χ^2 On methods used to provide extension messages……54

Table 4.13 Solutions to challenges in accessing extension services…….....55

Table 4.14 Types of feeds given to chicken…….....56

Table 4.15 χ^2 on Types and safety of feeds given to indigenous chicken…….57

Table 4.16 Types of chicken housing structures……...59

Table 4.17 Requirements for a standard poultry house……60

Table 4.18 Disinfectants used in chicken houses……...63

Table 4.19 Safety of chicken feeding materials…….....65

Table 4.20 Sources of breeding stock…….....66

Table 4.21 Mode of transporting breeding stock from source to the farm……....67

Table 4.22 Methods used to manage diseases and parasites…….....69

Table 4.23 Disease and parasites control strategies used by farmers……74

Table 4.24 χ^2 Statistics on diseases and parasite control strategies……...76

Table 4.25 Methods used to control and affordability……77

Table 4.26 Effect of environment on chicken productivity …….....79

Table 4.27 Pairwise ranking of challenges facing IC production in Kikumini/Muvau….81

Table 4.28 Pairwise ranking of challenges facing IC production in Kithungo/Kitundu...82

Table 4.29 Pricing of chicken at different ages…….....84

LIST OF PLATES

LIST OF PLATES **page**

Plate 4.1: Some poorly constructed chicken houses found during the survey..... 60

Plate 4.2: Some well ventilated and well aerated chicken houses 62

Plate 4.3: Chicken house with fenced chicken run around it……..…….62

Plate 4.4: Some ways used to transport breeding stock from source..…….68

Plate 4.5: Focussed group discussion in Kikumini/Muvau ward..……82

Plate 4.6: Focused group discussion in Kithungo/Kitundu ward…….....82

LIST OF FIGURES

Figure 2.1 Concept frame work…….24

Figure 3.1 Location of Makueni in Kenyan Map…….....28

Figure 3.2 Livelihood zones in Makueni County……..30

Figure 3.3 Map of Makueni Sub-county……33

Figure 3.4 Map of Mbooni Sub-county…….34

Figure 4.1 Level of education of the respondents…….40

Figure 4.2 Types of livestock kept I the study sites……..41

Figure 4.3 Breeds of livestock kept……...42

Figure 4.4 Reasons for keeping indigenous chicken…….44

Figure 4.5 Methods of raising chicken……..44

Figure 4.6 Chicken diseases experienced…….46

Figure 4.7 Parasite infestation management…….49

Figure 4.8 Training on Chicken management……49

Figure 4.9 Frequency of Training……..50

Figure 4.10 Effect of IC rearing constraints on productivity…….58

Figure 4.11 Fencing protection for Indigenous chicken……61

Figure 4.12 Animals the indigenous chicken interact with……70

Figure 4.13 Perception of adequacy of biosecurity in the farm…….71

Figure 4.14 Ownership of Indigenous chicken……..72

Figure 4.15 Ownership of land where IC are kept…….72

Figure 4.16 Number of HH members working in the chicken unit……...73

Figure 4.17 Person making decision to treat chicken……75

Figure 4.18 Chicken marketing channels in both wards……..78

Figure 4.19 Future trend in Indigenous chicken production…….80

ABBREVIATIONS AND ACRONYMS

ABD	Agricultural Business Development
Ag GDP	Agricultural Gross Domestic Product
ASALs	Arid and Semi-Arid lands
CBO	Community Based Organization
CCAFS	Climate Change Agriculture & Food Security
CDA	County Director of Agriculture
CDLP& V	County Director of Livestock production & veterinary
CIDP	County Integrated Development Plan
CTA	Technical Centre for Agricultural and rural development
DAL&F	Department of Agriculture, Livestock and Fisheries
DANIDA	Danish International development Agency
EU	European Union
FAO	Food and Agricultural Organization of the United Nations
FFS	Farmer Field School
FIPs	Africa-Farm Input Promotions -Africa
GoK	Government of Kenya
HH	House Hold
IC	Indigenous Chicken
ICPALD	IGAD Centre for Pastoral Areas & Livestock Development
IGAD	Intergovernmental Authority on Development
IEBC	Independent Electoral and Boundaries Commission
IFPRI	International Food Policy Research Institute
KARI	Kenya Agricultural Research Institute (KALRO-Currently)
KES	Kenya Shillings
KIPPRA	Kenya Institute of Public Policy Research and Analysis
KNPIP	Kenya National Poultry Improvement Programme
KNBS	Kenya National Bureau of Statistics

LM	Lower Medium zone
MAP	Makueni Agricultural Project
MESPT	Micro Enterprise Support Programme Trust
MOLD	Ministry of Livestock Development
MOLFD	Ministry of Livestock and Fisheries Development
MCCU-SP	Makueni County Cooperative Union-Strategic Plan
OECD	Organization for Economic Cooperation and Development
OIE	Organization Mondiale de la Sante Animale (World organization for Animal Health)
PSPK	Partnership for Safe Poultry Kenya
SPs	Service Providers
SPSS	Statistical Package for Social Sciences
SSA	Sub- Saharan Africa
UM	Upper medium Zone
USA	United States of America
USAID	United States Aid for International Development
WEEC	Women Entrepreneurship Empowerment Consortium

DEFINITION OF TERMS

For the purpose of this study, these terms are used in the following context;

House hold (HH) - refers to people living together in one house and sharing a meal from same kitchen-(Merriam-Webster learner's dictionary)

Small holder producers - These are usually farms supporting a single family with a mixture of crops and livestock on subsistence basis, relying more on family labour, more valued primarily for rural lifestyle (Wikimedia Foundation) and for this study,- similar farms but with land size of 1-10 acres and chicken flock size of less than 120 birds.

Indigenous Chicken (IC) - Chicken that are very heterogeneous population exhibiting wide variation in size, plumage, colour, comb type and skin colour (Kibet, 2013). For this study IC refers to chicken that are adapted to harsh environmental conditions, which include extensive, small scale village free range kept birds.

Biosecurity- Biosecurity refers to measures that are taken to stop spread or introduction of harmful organism to humans, animals and plants (Asanya Mandal, 2014). For the purpose of this study, it referred to the practices employed by poultry farmers to prevent diseases from spreading into their farms. Such practices include fencing, vaccination, traffic controls, use of foot baths, disinfection and cleanliness of both chicken houses and equipments.

Adoption of biosecurity measures – checks whether an individual in chicken production has used or is using innovations or technologies in ensuring biosecurity in their farms.

Diffusion - refers to how technology and skills have spread within the community; and for this study, how biosecurity measures have spread within the indigenous chicken producers in the study area.

ABSTRACT

Annually Kenya produces about 20 million tons of poultry meat worth KES 3.5 billion and 1.3 billion eggs worth KES 9.7 billion. However Indigenous chicken productivity has stagnated due to limited transfer and adoption of improved technologies such as biosecurity practices by rural households. The productivity of Indigenous chicken has been decreasing in Makueni County despite development agencies, both national and international and county government investing heavily in chicken enterprise. There is also limited adoption of biosecurity measures. A survey was conducted in Kikumini/Muvau ward of Makueni sub-County and Kithungo/Kitundu ward in Mbooni sub-County. Systematic sampling were done to select the two sub-counties out of six that form Makueni county based on Agro-ecological and livelihood zoning, concentration of agricultural activities and investment levels in chicken enterprise in these sub-counties. Random sampling was used to select the two wards and simple random sampling to select households (from a source list provided by area chiefs). The objectives of the study were; i) To identify the constraints that affect the productivity of indigenous chicken in Kikumini/Muvau and Kithungo/Kitundu wards; ii) To establish the biosecurity measures practiced by indigenous chicken farmers in the two wards and, iii) To assess the socio-economic and ecological hindrance to adoption of biosecurity measures in the two wards. To obtain primary data, the study interviewed 158 respondents (72 in Kikumini/Muvau and 86 in Kithungo/Kitundu wards). Two focus group discussions (one in each ward) were also conducted. The collected data was cleaned, and 143 questionnaires were found valid, they were coded and analyzed through Microsoft excel, version 2010 and also the Statistical Package for Social Sciences (SPSS) version 17.0 computer software. Descriptive statistics dispersion, frequencies, means, distribution and Chi-square were conducted to compare study variables for each specific objective. In both study wards some of the biosecurity measures adopted were vaccination, fencing, and disinfection, cleaning of chicken houses and equipment and traffic control. The main constraints that have negatively affected chicken productivity as reported by 85.3% of respondents were diseases and parasites, high cost of chicken feeds, poor housing, inadequate chicken rearing skills and inadequate knowledge on biosecurity. The cold months of June-August results in disease outbreaks, bushes around the homesteads that hide predators, are some of the environmental challenges on chicken productivity. Overall the study concluded that, IC farmers in the two study wards have adopted some biosecurity measures, respondent occupation, type and safety of feeds and channel of disseminating extension messages to farmers have significant influence on adoption of biosecurity measures, while ownership of IC, ownership of land and standard of chicken house does not significantly influence adoption of biosecurity measures. The study therefore recommends that; affordable credit facility to IC farmers be developed to support them improve on biosecurity strategies and dissemination of chicken production messages to be channelled more through Radio. There is also need for development of biosecurity policy for livestock enterprises in Makueni County.

CHAPTER ONE

1.0 INTRODUCTION

1.1 Background of the Study

Agriculture plays a significant role in Kenya's economy. The sector directly contributes 24% of the GDP and another 26% indirectly (ASDSP, 2013). Agriculture is the second largest industry after the service sector, accounting for approximately $58 billion earnings annually. The sector accounts for 65% of Kenya's total exports, 18% and 60% of formal and total employment respectively (KIPPRA, 2013). Small-scale farmers dominate Kenya's agriculture accounting for 75% of the total agricultural output. This sector supplies the manufacturing sector with raw materials and generates tax revenue and foreign exchange that support the rest of the economy. The sector employs over 40% of the total population (ASDSP, 2013) and is the main source of livelihood to almost 80% of Kenyan population living in the rural areas (KIPPRA, 2013). The Vision 2030 development plan has identified agriculture as one of the key sectors to deliver the 10% annual economic growth rate envisaged under the economic pillar (ASDSP, 2013).

Livestock plays important economic and socio-cultural roles among many Kenyan communities. It is used as a measure of wealth and insurance against drought in pastoral communities, payment of penalties, dowry and settling of disputes amongst families in many regions of Kenya. The livestock sub-sector contributes to the food and cash needs of the farmers, and provides employment to about 10 million people, contributes 7 per cent to the GDP. It also provides 50% of the agricultural labour (GoK, 2010). Kenya had an estimated 11,479,414 tropical livestock units (TLU) comprising cattle, sheep, goats, donkeys, camels, pigs, poultry (including ostrich) and rabbits valued at Ksh. 264.8 billion (equivalent to US$4.4 billion) in 2006 (Omiti and Okuthe, 2010). The sub-sector accounts for about 30 per cent of total agricultural products, which earn the country foreign exchange through the export of live animals, dairy products, hides and skins. Livestock has poverty-reducing potential (KIPPRA, 2013). Financial benefits from livestock keeping, including the provision of credit, insurance, and as a means of sharing risk. The credit benefits of livestock derive from the ability of livestock owners to 'cash

in' their animals for particular purposes (Behnke and Muthami, 2011). Most rural families in Kenya (an estimated 75%) keep chicken. Indigenous chickens contribute 71% of the total egg and poultry meat produced in Kenya and therefore impact significantly on the rural trade, welfare and food security of smallholder farmers (Nyaga, 2007 b.). Kenya has an estimated poultry population of 31 million birds. Of these, 75% (23.8 million) consist of indigenous chicken, 22% (6.9 million) of broilers and layers and 1% of breeding stock. Other poultry species like ducks, geese, turkeys, pigeons, ostriches, guinea fowls and quails make up 2 % of the poultry production (MOLFD, 2012). While indigenous chicken are mainly found in rural areas, broilers and layers are kept in urban areas.

In Makueni County, approximately 50 chicken producer groups with an outreach approximated at 10,000 farmers have been trained and coached (by government staff and other technical officers from several development agencies) on the importance of improved bio-security and safe poultry production practices. However very few (20%) follow and adhere to vaccination programmes for their birds and have improved housing (MESPT, 2015). Chick mortality still remains as high as 80–90% within the first six weeks after hatching, due to diseases, parasites, lack of feed, poor housing, insufficient water supply and predation. This is caused by inadequate knowledge on biosecurity requirements among farmers. Newcastle disease (NCD) is still a menace in Makueni. On the average indigenous chicken flocks size per household range between 13-50 birds (including the breeding stock). It takes 5 to 6 months a bird to attain 1.2-2 kilograms dressed weight. Poultry farmers are able to achieve an average of 20 eggs per clutch totalling to 60 eggs per hen per year per. Although not all are sold, a tray of 30 eggs currently retails between Ksh 360-450 in Wote market (the County head quarters). At the farm gate, the price of a live chicken weight of 2kg sells from Ksh 400-500 for hens and Ksh 600-800 for a cockerel. Price at the outlet (pubs, bars, hotels and restaurants) is 1000/- to 1200/- per bird of 2kilograms live weight (MESPT, 2015).

Table 1.1 Livestock population trend in Makueni County 2010-2015

	YEAR				
Livestock Type	2010	2011	2012	2013	2015
Beef cattle	263320	271550	281490	289500	233814
Dairy cattle	31624	29259	28562	27286	22353
Goats	642611	657114	628711	617060	675045
Sheep	109244	108419	117607	116110	115011
Chicken	984020	812300	656704	627792	647965
Pigs	2251	1860	1155	1285	2040
Rabbits	6480	1060	8020	1285	2050
Bee hives	65418	64071	65467	64675	63240

Source: Department of livestock and veterinary services-Makueni County, 2016

From the above figures, there is no markable increase of chicken numbers between 2012 and 2015. A major decrease is noticed between 2010 and 2013.

Poultry meat is the fastest growing component of global meat production, consumption, and trade, with developing and transition economies contributing a leading role in the expansion. The livestock sector, poultry included, is expected to continue to meet rising world demand for animal products cheaply, quickly and safely (Aila *et al.,* 2012). Despite increasing demand for IC products by local consumers, their low productivity, attributed to high disease incidences, inadequate nutrition, low genetic ability and poor marketing channels, reduce their contribution to rural development (Mwobobia *et al.,* 2015). These reports and others indicate that;- i) indigenous chicken have not attained their full production potential due to exposure to risks that militate against their survival and

productivity. Control of common diseases in the free-range system could improve survival rate of chicks by at least 30% while improved feeding, housing and disease control could increase survival rate to 80% (Odwasy *et al.*, 2006). The backyard poultry producers use inputs with little or minimum external sources. These include; poor quality feed and mixed cereals, local breeds sometimes crossbred with improved breeds obtained from extension services or neighbouring farmers, minimal veterinary services, local labour and traditional housing systems (Aila *et al.*, 2012). ii) Indigenous chicken are predominantly produced in village backyards with little or no biosecurity measures. These production systems are characterized by unconfined birds that scavenge around the homestead and often interact with wild bird species in the process (Aila *et al.*, 2012) and other livestock.

Biosecurity refers to all the management practices aimed at excluding or reducing the potential for the transmission and spread of diseases to animals, humans or an area initially free from the diseases causing agents. Uncontrolled traffic into poultry farm have serious implications on the spread of contagious poultry diseases by people and vehicles (Ameji *et al.,* 2012). Biosecurity requires the adoption of a set of attitudes and behaviours by people to reduce risk in all activities involving domestic, captive, exotic and wild birds and their products (FAO, 2008). However biosecurity is still very weak and requires improvement at all levels. Currently, the sanitary risk taken by producers is low, and is balanced against the prices of inputs and outputs in indigenous chicken enterprise (Paola *et al.*, 2008). Biosecurity measures are not well adopted despite being included in the extension packages. Producers may choose not to implement biosecurity recommendations because of a lack of awareness about the potential risks to their farms and the industry as a whole. Among those who are aware of the potential risks belief that, benefits of implementing biosecurity measures do not outweigh the costs, (Moore *et al.,* 2008).

1.2 Problem Statement

In Makueni (IC) productivity has stagnated in recent years, largely due to numerous constraints such as: - diseases, parasites, inadequate knowledge and skills on IC husbandry, limited transfer and adoption of improved technologies by rural households. Investments aimed at improving IC production have not achieved desired outputs. No policy on livestock biosecurity in Makueni County. Recent reports from the department of veterinary services indicate that, chicken mortality is on the rise 70-80% (DALF, 2015).

1.3 Objectives of the study

1.3.1 General Objective

The general objective of the study was to assess the challenges facing indigenous chicken production and adoption of biosecurity measure in Makueni County and how this influences productivity.

1.3.2 Specific Objectives

i. To identify the constraints that affects the productivity of indigenous chicken in Kikumini/Muvau and Kithungo/Kitundu wards
ii. To evaluate the level of adoption of biosecurity measures practised by indigenous chicken farmers in the two wards
iii. To assess socio-economic and ecological factors that hinder the adoption of biosecurity measures in the two study sites.

1.4 Research questions

i. What are the constraints affecting productivity of indigenous chicken in Kikumini/Muvau and Kithungo/Kitundu wards?

ii. How do the indigenous chicken farmers practice biosecurity measures in the two study wards?

iii. What are the socio-economic and ecological factors that hinder adoption of Biosecurity measures in indigenous chicken production in the two study sites?

1.5 Justification of the study

Makueni County is 87% Arid and Semi-arid (ASAL) and very marginal to crop production. Livelihoods within the rural communities hinge predominantly on subsistence agriculture, which is primarily the responsibility of women. Among the livestock enterprises, poultry production is the most widespread in Makueni County. About 75-80% of all farm families in this County keep poultry, most of which are indigenous chicken (Makueni CIDP, 2013). These birds are kept on free range (scavenging) systems of production. These systems subject chicken to risk of disease outbreaks and high infestation by parasites.

The low productivity of IC can also be partially attributed to the fact that traditionally kept chickens receive little care as they often coexist in the same households as exotic birds in small-scale and backyard farms, (Paola *et al*., 2008). Past efforts by several projects such as Word vision, DANIDA funded- Makueni agricultural project (MAP), Women Entrepreneurship Empowerment Consortium (WEEC) programme, Partnership for Safe Poultry in Kenya (PSPK) project, Agricultural Business Development (ABD) project, VETWORKS Eastern Africa poultry restocking project, Heifer international, Africa harvest Biotech Foundation International programme, Farm Input promotions-Africa (FIPS-Africa), Anglican Development Services (ADS)-Eastern and County government funded poultry promotion projects have not resulted in any significant change in this sub sector (in terms of volumes of marketable birds). Improvement and commercialization of IC and their products is still low. The study will unearth the challenges faced in indigenous chicken production, the biosecurity measures adopted and socio-economic and ecological hindrances to indigenous chicken productivity. This will enable recommendation for necessary interventions to increase indigenous chicken

productivity and improve household incomes and subsequently reduce poverty level in Makueni county recorded at 64% (KNBS, 2010).

1.6 Theoretical framework

Biosecurity refers to all the management practices aimed at excluding or reducing the potential for the transmission and spread of diseases to animals, humans or an area initially free from the diseases causing agents (Ameji *et al.,* 2012). Biosecurity also refer to those measures taken to prevent or control the introduction and spread of infectious agents to a flock. Such infectious agents, whether causing clinical or subclinical diseases, significantly reduce the productivity, profitability and long term financial viability of a poultry operation. Biosecurity may also refer to the implementation of policies and practices that prevent the introduction and spread of diseases (Nyaga, 2007a). Biosecurity is still very weak and requires improvement at all levels. Currently, the sanitary risk taken by producers is low, and it is balanced against the prices of inputs and outputs, and is mainly related to poultry diseases (Paola *et al.*, 2008). Poultry farmers in Makueni have inadequate knowledge and skills to control IC diseases and chicken mortality is on the rise (70-80%).

1.7 Limitation

Due to previous studies carried out in Kikumini/Muvau ward without feed back to the community, respondents from some households were reluctant to participate in the study. Thus some of them raised complain that they had given research information for long and the area has not benefited from previous studies. Enumerators spent valuable time to convince them in order to participate in the study. The study was also conducted when farmers were busy clearing their farms. In some instances the enumerator could not find any one to interview at a given household and the design was that the enumerator goes to the next nearest household on the right hand side.

1.8 Scope

The study administered questionnaires to 158 randomly selected households and held 2 focused group discussions participated by 17 members (9 males and 8 females) in Kikumini/Muvau and 16 members (11 males and 5 females) in Kithungo/Kitundu wards. These households represented the population of 3060 and 3523 indigenous chicken producers in both sites respectively. The questionnaire had four sections;-A) General information of the respondent, B) Constraints that affect the productivity of indigenous chicken in Kikumini/Muvau and Kithungo/Kitundu wards, C) Biosecurity measures carried out in the two study wards, and D) Socio-economic and ecological drivers that hinder adoption of biosecurity measures in the two study wards.

1.9 Assumptions

In this study, the assumptions were as follows:

i) That the information obtained from respondents will be accurate.

ii) The number of households randomly selected are an adequate representative of farmers in the study wards

iii) That the responses represent common practices amongst all chicken produces in the study area and the entire Makueni County in general.

CHAPTER TWO

2.0 LITERATURE REVIEW

2.1 Introduction

2.1.1 Importance of livestock to human welfare

Farm animals and their products have a long standing and successful history of contributing significantly to human nutrition, clothing, labour, research, development and medicine (Kues and Niemann, 2004). Livestock keeping additionally contribute to multiple livelihood objectives and offers many pathways out of poverty. Such contributions includes and not limited to supply of food, income generation, manure, traction power, and enhancing social status (Randolph *et al.*, 2007). Further, livestock also serve as financial instrument to the poor who often do not have access to standard financial market such as banks (Randolph *et al.*, 2007). In 2009, livestock contributed US$ 4.54 billion to Kenya's Agricultural Gross Domestic Product (AgGDP), (ICPALD, 2013).

Animal production in general and chickens in particular play important socio-economic roles in developing countries. Production of village chickens is a source of easy and regular income for rural farmers in developing countries (Kondombo, 2005). Unfortunately efforts to improve their productivity has not been effective and village chickens productivity is still low (Kondombo, 2005). Poultry meat represents about 33% of global meat production. In 2007, some 269 million tons of meat were produced globally, of which 88 million tons (32.7%) were poultry meat. Chicken accounts for about 86% of all poultry reared worldwide. In the European Union (EU), chicken meat accounted for 79% of all poultry meat produced in 2007, while turkey, duck, pigeon, geese and quail meat accounted for 15%. Hen eggs represent 92% of the global primary production of eggs. The indigenous chicken (*Gallus domesticus)* have been kept in Africa for many generations in subsistence farming systems. They currently constitute about 80% of the continent's poultry flock and 73% of the chicken in Kenya. However,

improved management strategies are limited or non-existent in most of these systems as reported by Menge *et al.*, 2005. Poultry meat is the fastest growing component of global meat production, consumption, and trade, with developing and transition economies contributing a leading role in the expansion of these enterprises (Aila *et al.*, 2012).

Poultry production is gaining popularity in the developing countries due to its role in bridging the protein availability gap, economic empowerment of the resource poor segment of the society and also fits well in the farming systems commonly practiced in these countries (King'ori *et al.*, 2010). Chicken meat and eggs are the best source of quality protein, and are needed by the many millions of people who live in poverty. In sub-Saharan Africa (SSA) and South Asia, malnutrition (also referred to as poor nutrition) and under-nutrition (inadequate nutrition) are closely associated with poverty (Farrell, 2010). The importance of poultry production to the biological needs, economic and social development of the people of any nation cannot be over emphasized. The poultry industry has become a popular means of alleviating poverty in Nigeria and many other countries in Africa (Augustine *et al.,* 2010). Poultry production is a major source of livelihoods for many Kenyans. In a recent study of smallholder families in Kenya, farmers' ranked poultry keeping as the most important household occupation affecting their livelihoods in several ways (Nyaga, 2007 b). Poultry eggs and meat are used for home consumption where they contribute much to the family nutrition. Consumption of poultry eggs and meat at household level saves pulses which are sold to bring in more income into the household or used for other household needs (Nyaga, 2007-b). Nyaga also noted that poultry not only play a significant role in food security for farmers and rural communities but also for urban dwellers as well.

2.2 Status of the global poultry sector

The poultry sector has undergone major structural changes during the past two decades due to the introduction of modern intensive production methods, genetic improvements, improved preventive disease control and biosecurity measures, increasing income and human population, and urbanization. These changes offer opportunities for poultry

producers, particularly smallholders, to improve their farm income (Narrod *et al.*, 2007). Growth in livestock production in both developed and developing countries has been led by poultry. From the 1990s to 2005, consumption of poultry meat in developing countries increased by 35 million tones – almost double the increase that occurred in developed countries. The increase in poultry meat consumption has been most evident in East and Southeast Asia and in Latin America, particularly in China and Brazil. Poultry meat consumed in developing countries rose from 43 to 54 percent between 1990 and 2005. Further, the proportion of the world's poultry meat produced in developing countries also rose from 42 to 57 percent (Narrod *et al.*, 2007).

It is estimated that production and consumption of poultry meat in developing countries will increase by 3.6 percent and 3.5 percent, respectively, *per annum* from 2005 to 2030 because of rising incomes, diversification of diets and expanding markets, particularly in Brazil, China and India (IFPRI, 2007). By 2024 poultry meat consumption in the developed economies is expected to have risen from 5.2 million tonnes to 48.8 million tones, while for the developing nations a 16.7 million tonnes increase is anticipated as the total rises to 84.2 million tonnes. Chicken meat accounts for around 89 per cent of poultry meat availability, so by 2024 chicken uptake could be in the region of 118 million tonnes. The factors that could cause this kind of demand are: (1) increases in income; (2) increases in the price of other meat such as pork or beef; (3) increases in the preference for poultry; and (4) decreases in the price of poultry complements. Other factors include increases in real per capita incomes, urbanization and variations in real prices (Narrod *et al.*, 2007).

2.3 Status of poultry production in Kenya

Poultry production in Kenya and in particular indigenous chicken (IC) production plays a significant role in the economic and social life of these resource-poor households, contributing to cheap source of animal proteins and cash income. Indigenous chickens are present whenever there are human settlements and their economic strength lies in their

low cost of production which is a characteristic of the resource-poor rural households. They are highly adapted to the harsh scavenging conditions, poor nutrition and disease and/or parasite challenges (Magothe *et al.*, 2012). Demand for IC meat is on the increase due to awareness and health concerns. However reports indicate low productivity with a decreasing trend more so on free range indigenous chicken production systems. Importantly, the little output obtained from keeping poultry contributes to the household income and provides access to high-quality proteins, which are generally in short supply (Kryger *et al*., 2010) more so in Kenya. Biosecurity is still very weak and requires improvement at all levels. Currently, the sanitary risk taken by producers is low, and is balanced against the prices of inputs and outputs. This is mainly related to poultry diseases (Paola *et al.*, 2008).

2.4 Poultry in smallholder production systems

Smallholder poultry production is practiced by most of the rural households throughout the developing world where most of the indigenous poultry are mainly being produced by small scale farmers. Smallholder farming system refers to the many diverse forms of production found in smallholder societies across the world (Kryger *et al*., 2010). Smallholder farming systems worldwide constitute a many different ways of providing livelihoods for rural families, depending on the; (i) agro-ecological conditions, (ii) socio-cultural factors, (iii) access to markets at the local, national and international levels and (iv) possibilities for generating income from non-farm activities. However, there appears to be a remarkable similarity in the role of poultry in (rural) farming systems across regions, agro-ecological zones and cultures (Nyaga, 2007 b).

Village poultry is kept with minimal input of resources and is considered by most smallholders as supplementary to the main livelihood activities (Jens *et al*., 2004). The birds scavenge to find feed and are rarely provided with anything more than kitchen leftovers. Sheds, if provided, are made of local materials. Poultry keepers in smallholder systems also lose many birds as a result of diseases and exposure to predators. The birds are mainly of indigenous breeds, sometimes mixed with exotic breeds. The productivity

of village poultry is low, but yet contributes to the household income and provides access to high-quality proteins (Kryger *et al*., 2010). It is a broadly accepted rule of thumb, confirmed in numerous studies that about 60-80% of rural households in developing countries keep poultry in either scavenge based or free-range systems. The two systems are also referred to as "village poultry" systems (Kryger *et al*., 2010). These systems are characterized as low-input and low-output, mainly involving rural or peri-urban households that generally keep indigenous breeds for consumption (Nyaga, 2007 a).

2.5 Scavenge based poultry production systems and their challenges

In Africa, traditional poultry husbandry has the following characteristics; (a) the birds range freely during the day and are usually gathered at night into a basic shelter to avoid losses through predators, (b) the feed is limited to what the birds can find by themselves (insects, seeds, kitchen wastes), but sometimes a supplement is given depending on the availability of the feedstuffs used in the household, (c) the productivity of village chickens production systems in general and the free range system in particular is known to be low and (d) high mortality rates are registered (Kondombo, 2005). The production systems are faced with myriads of challenges. In most extensive production systems, chicken production receive limited institutional support services such as extension services, credit, veterinary services, training and marketing of the products. This is a challenge especially where a producer wishes to commercialize the enterprises (Ochieng *et al.,* 2013). The other production constraints highlighted by farmers include theft of the birds, high costs of feeds especially commercial feeds, climatic conditions and lack of knowledge in production skills and general management of indigenous chicken enterprises (Ochieng *et al.*, 2013).

In their study in Swaziland, Bongani and Masuku (2013) found that, farmers were constrained by lack of fencing material, lack of chicken housing and equipment and high disease incidences, lack of organized market, predators, low productivity of the chickens, lack of vaccinations to control diseases, slow growth and maturity of indigenous chickens, lack of credit to buy capital equipment, chicken theft, low market prices and

high mortality rates of stock. As a result, the productivity of these chickens is usually low. These findings agree with another report by (Kryger, 2010) who noted that production levels of scavenging birds are usually considered to be low, especially when compared with those of commercial chicken. This is due to high chick mortality rates (estimated 70 per cent) before they reach the age of six weeks owing to a combination of diseases, predation and lack of adequate feeds.

The indigenous chicken sector exhibits a very low adoption of biosecurity practices (Aila *et al.*, 2012). Limited Biosecurity measures combined with close and frequent contact between wild birds and humans also increase the risk of introduction and spread of diseases and parasites (Ndirangu *et al*., 2009). It has become imperative (Ndirangu *et al*., 2009), to give priority to poultry health management through the implementation of sound biosecurity measures especially in developing nations that are strangling with many social problems. The effective implementation of biosecurity measures will minimize the problems of disease outbreak and spread in the poultry industry and also maintain consumers' confidence in poultry products. Indigenous chicken are mostly owned and managed by resource poor farmers who are mainly women and children (Wachira *et al*., 2009), who do not invest much, particularly in biosecurity measures to control diseases and parasites. In order to produce safe poultry, improved bio-security practices, that allow the development of strategies and measures that encourage sustainable poultry production and effective disease control are essential (Nyaga, 2007 a).

2.6 Constraints in chicken production

In nearly all African countries, constraints facing poultry industry can basically be categorised into; production, socio-economic, socio-cultural, Infrastructural, institutional and technical.

2.6.1 Production constraints

Under production constraints, reproductive wastage and mortality is critical. Village chicken flock productivity is mainly determined by egg production, hatchability, survivability of chicks and growth rates. The flock size is a function of egg production per hen and the proportion of mature laying hens in a flock (the reproductive performance is generally low, hens lay 30-80 small eggs/hen/year under smallholder conditions and survivability levels vary from 20-70%). Chick mortality represents a major loss (Mapiye *et al.,* 2008). Low productivity of local chicken is associated with low egg production performance, production of small sized eggs, slow growth rate, late maturity, small clutch size, an instinctive inclination to broodiness and high mortality of chicks (Fisseha *et al.*, 2010). In a recent study in Upper West region of Ghana it was reported that, problems encountered by the farmers include inadequate capital, expensive feed and equipment, incidence of diseases and poor weather conditions (Butler, 2016).

While most poultry in Africa's developing countries is still kept by smallholders, the poultry industry's main challenges in Africa include high price of feed raw materials (such as maize and soya), inadequate extension or advisory services to support developing farms infrastructure such as roads (Oosthuysen, 2013). In Kenya, despite increasing demand for IC products by local consumers, their low productivity, attributed to high disease incidences, inadequate nutrition, low genetic ability and poor marketing channels, reduce their contribution to rural development (Magothe *et al.*, 2012). The chicken are kept under scavenging production systems with limited application of management interventions to improve flock productivity. With constraints such as diseases, lack of proper housing and insufficient feed, the productivity of these chickens is usually low, concluded the study by Bongani and Masuku (2013). Similar constraints were earlier reported by Okitoi and Mukisira (2001) that poor management, lack of food supplementation, lack of disease control measures and inappropriate housing have constrained indigenous chicken production.

Other recorded challenges facing the poultry industry include; expensive vaccine, expensive veterinary services, management of sick birds, low patronage of live birds due to few restaurants and hotels in the Wa municipality (Butler, 2016), which is no different in many African countries. Other studies also agree that, productivity of local chickens is poor in the tropics, and that is attributed to low genetic potential, feed problems and diseases (Mammo, 2012). In Ethiopia periodic disease outbreaks and inadequacy of Scavenging Feed Source (SFS) are common limiting factors that affect performances of village chickens noted (Mammo, 2012). In resource-poor households, chickens do not receive adequate nutrients, they are susceptible to diseases and parasites, are prone to predation and there are no marketing structures exist for these village chicken (Gwala, 2014). These coupled with lack of veterinary services, chicken losses due to predation and theft, lack of feed resources and lack of market support are ranked as major constraints to improvement of village chicken production.

Poor disease and parasite control, low body weight of birds, predators (like hawk, cats, dogs), poor growth rate and low educational level of farmers are common constraints. Diseases and predators have also continued in retarding the productivity of poultry (Chah *et al.,* 2014). In their study in Hadiya Zone of Ethiopia, Salo and co-authors found that, chicken production in the study area was hindered by poor management like health care, feed shortage, lack of improved breed and predators (Salo *et al.,* 2016),with diseases, predators, feed shortage and lack of improved breed being the main constraints of chicken production. This agrees with the findings by Ndirangu *et al*., (2009), King'ori *et al.,* (2010), and Kyule *et al.,* (2015). In his study carried out in Mashuru and Loitoktok divisions of Kajiado district (Ndathi *et al.,* 2012) found that predation through both aerial and terrestrial predators, pests and diseases were ranked number 2 in 3 out of the 5 study sites.

2.6.2 Socio -economic constraints

The success of a chicken production enterprise is judged by the quantity and quality of products sold (number of chickens and eggs) and consequently, the amount of profit gained- a function of market and market management. In Zimbabwe, lack of markets and marketing skills are some of the major drawbacks of village chicken production system. Marketing of chicken and eggs in the smallholder sector is informal and tends to be within the local communities, between farming households and to some non-farming households. Most farmers depend on hawkers or middlemen who buy birds for urban markets as reported by (Mapiye *et al.,* 2008). In Osun state of Nigeria, among the socio-economic constraints identified (Adebayo and Adeola, 2005) were inadequate finances and inputs. Only few respondents had access to credit facilities or loan from financial institutions. Additional constraints reported in this study were access to extension and veterinary services, labour and market had negative impact on production (Adebayo and Adeola, 2005). Similar findings were indicated in a study in Swaziland, compounded constraints were; high disease outbreak; lack of fencing and housing; high feed costs; lack of reliable markets; low volumes; lack of credit access; poor growth and maturity and low market prices (Bongani and Masuku, 2013). Women owned more village chickens compared to their male counterparts. Households that reared large chicken flock sizes of village chicken also reared goats and cattle whereby goats were more important for income generation. Village chicken are kept for meat consumption within the households and were slaughtered during transitory periods and times of food shortages and during performance of cultural rituals (Gwala, 2014).

In another study on constraints and opportunities in indigenous chicken production and marketing in Mashuru and Loitoktok divisions of Kajiado district by Ndathi et al., (2012), marketing was highly ranked in the 5 sites. The major factor affecting marketing was low buying prices being offered by traders in the local markets. Low availability and high cost of chicken feeds was ranked second most important constraint in Merueshi sub-location (one of the study sites) (Ndathi *et al.,* 2012). In a study by Kyule *et al.,* 2015 in

Njoro sub-County of Nakuru County, Kenya, shortage of labour, neighbourhood conflict, chicken theft and poor marketing information were some of the socio-economic constraints in chicken production in this study area. In Kajiado socio-economic constraints observed were low and/lack of knowledge on the basic chicken production requirements by the Maasai pastoralists and low availability of drugs for disease and pest management (Ndathi *et al.*, 2012).

2.6.3 Socio-cultural constraints

Many socio-cultural factors affect livestock production. Socio-cultural constraint to poultry development is the value placed upon poultry for use at ceremonies and festivals or even as a source of income in times of need. Some regard chickens as their pets or part of the family, thus it is only the arrival of an important unexpected visitor when they use it as food (FAO, 2008). This state of affair negatively affect the production of village poultry.

Another major socio-cultural constraint to poultry production is the high value placed upon crop production rather than livestock production. This affects the willingness to put much time, expense and effort into livestock production (more so chicken) (FAO, 2004). Typically, where crop farming is the men's main activity, keeping livestock is perceived as a peripheral activity relegated to women and children. However, when the number of livestock increases, men usually take over the activity (FAO, 2004). Indigenous (village) chicken production is part of a balanced farming system, it plays an important role in supply of high quality protein to the family food balance, and provides small disposable cash income in addition to ceremonial and socio-religious functions, that are important in the rural people's lives (Fisseha *et al.*, 2010).

In Kajiado; dominated by Maasai pastoralists, socio-cultural beliefs and negative feeling towards chicken keeping include, nuisance of the chicken within the homestead such as scratching the walls of the houses, disturbing the ladies in the kitchen as they look for

feeds and incompatibility of chicken production with the nomadic lifestyle is indicated as social constraint (Ndathi *et al.,* 2012).

2.6.4 Infrastructural, institutional and technical constraints

Infrastructural constraints include lack of research and education on infrastructure serving the village chicken production system and poor physical infrastructure; roads, energy, water supply and communication technology. Lack of farm input supply services tailored to the needs of the smallholder farmers, lack of access to credit facilities and lack of access to profitable urban markets are some of the institutional constraints.

Technical constraints include inadequate knowledge, lack of farmer training systems, dearth of information about cost effective chicken and egg production at the level of decision makers and advisers at producer level and inappropriate system for supplying the farmer with technical assistance and advice (Mapiye *et al.,* 2008). Earlier reports (Adebayo and Adeola, 2005) also noted that infrastructure facilities and government policy had positive relationship with average production of poultry.

2.7 Biosecurity measures

2.7.1 Introduction

Infectious agents of poultry are a threat to poultry health and, at times, human health and have significant social and economic implications. In poultry production, especially under extensive conditions, prevention is the most viable and economically feasible approach to the control of infectious agents (OIE, 2016). Biosecurity is a practice designed to prevent the spread of disease into and out of a farm. It is accomplished by maintaining the facility in such a way that there is minimal traffic of biological organisms (viruses, bacteria, rodents, etc.) across its borders. Biosecurity is the cheapest, most effective means of disease control available. *Biosecurity* procedures should be implemented with the objective of preventing the introduction and dissemination of infectious agents in the poultry production chain (OIE, 2016).

2.7.2 Biosecurity in indigenous chicken production

2.7.2.1 Definition

Several scholars and researchers define biosecurity in various ways. Some refer to biosecurity as all the management practices aimed at excluding or reducing the potential for the transmission and spread of diseases to animals, humans or an area initially free from the diseases causing agents (Ameji *et al.,* 2012). Biosecurity also refer to those measures taken to prevent or control the introduction and spread of infectious agents to a flock. Such infectious agents, whether causing clinical or subclinical diseases, significantly reduce the productivity, profitability and long term financial viability of a poultry operation. Biosecurity may also refer to the implementation of policies and practices that prevent the introduction and spread of diseases (Nyaga, 2007a). 'Biosecurity' describes the systems put in place to protect people, animals and ecological systems against disease and other biological threats. Biosecurity is achieved through the practices that aim to prevent the entry, establishment and spread of diseases (Australian Government, 2009). Hanzler *et al.,* 2009, defines Biosecurity as management practices which reduce the spread of infectious diseases. It is the security from transmission of infectious diseases and parasites to a poultry production unit (Permin and Detmer, 2007) and can be seen as a set of preventive measures designed to reduce the risk of transmission of infectious diseases, quarantined parasites, invasive alien species, and living modified organisms. Biosecurity requires the adoption of a set of attitudes and behaviours by people to reduce risk in all activities involving domestic, captive, exotic and wild birds and their products (FAO, 2008).

2.7.3 Status of Biosecurity in Poultry production

Biosecurity is still very weak and requires improvement at all levels. Currently, the sanitary precautions taken by producers are few, are balanced against the prices of inputs and outputs, and are mainly related to poultry diseases (Paola *et al.*, 2008). According to Danielle and Thomson (2011), biosecurity programs have been developed for poultry

farms to control the transfer and spread of disease causing pathogens. A study in Kogi state Nigeria revealed high level of awareness and readiness to report Highly Pathogenic Avian Infection (HPAI) but poor knowledge and biosecurity practices towards them. In Nigeria, sectors 3 and 4 (rural extensive and backyard) are the commonly found poultry production systems (80%) with low or no biosecurity raising great concern about poultry and human health according to the study by Ameji *et al.,* 2012. While Biosecurity refers to all the management practices aimed at excluding or reducing the potential for the transmission and spread of diseases to animals, humans or an area initially free from the diseases causing agents, study in Kogi State in Nigeria found that, sanitation is poor, as greater majority of poultry farmers do not have footbaths and hand washing provisions in their poultry facilities. These have serious implications on the spread of contagious poultry diseases by people and vehicles (Ameji *et al.*, 2012). Biosecurity measures practiced in Ekiti State in Nigeria (Ajewole *et al.*, 2014) were general sanitations of the pens like regular clearing of the surroundings, regular packing of litters, regular cleaning of feeding and drinking troughs that recorded 100% compliance among the farmers. Other measures highly practiced include isolation of infected birds, traffic control and physical security of the farms.

2.7.4 Advantages of maintaining biosecurity measures at the farm

Studies have shown that in theory, if biosecurity practices such as fencing and traffic control into the poultry unit, infectious disease monitoring, plus disinfection and sanitation procedures, pathogens can be reduced to non-infective levels. Practical biosecurity must be developed by producers in order to prevent entry of diseases to the flock and is a tool that can minimize the effect of infections and decrease the impact of disease. Biosecurity must maintain tangible measures such as locks on gates, limitation of visitors, installation of showers, disinfection points, policies, protocols, quarantine rules, vaccination programmes and other preventive treatment measures (Aila *et al*., 2012).

2.8 Constraints facing adoption of biosecurity measures

The outcomes of researches have greatly been transferred from research institutes to the farmers through extension agents. However adoption of innovation among the grassroots farmers is very low due to, i) low coverage of farm families, ii) the quality of extension programmes, iii) the transfer of potentially beneficial new and underutilized technologies (Onasanya *et al*., 2006), who also further established that, the use of communication skills, media and methodologies is typically abhorred and fragmented. Too often, these are poorly integrated into the total extension programme. Biosecurity measures covered during trainings and demonstrations are;- vaccination, hygiene in poultry units, parasite control, fencing of poultry farms, use of foot baths, use of protective clothing and well protected chicken runs to control predation. Some producers may choose not to implement biosecurity recommendations because of a lack of awareness about the potential risks to their farms and the industry as a whole. Among those who are aware of the potential risks belief that, benefits do not outweigh the costs, (Moore *et al.*, 2008).

It is also possible that some producers choose not to implement biosecurity recommendations because of confusion as to the specific recommendations they should follow (Moore *et al*., 2008). There is therefore some question as to how extensive farm biosecurity programs need to be planned in order to prevent disease transmission. One factor that could motivate producers to adopt biosecurity practices for their operations (Moore *et al.*, 2008) is the potential to maintain business continuity during a disease outbreak.

The lack of adoption of biosecurity practices by producers is a complex issue, but the lack of a consistent message likely plays an important role concluded Moore's study. From a study in Indonesia it was found that, factors that may influence the type of biosecurity measures adopted by broiler and layer smallholder poultry farmers in Indonesia are characteristics of farmers e.g. experience as a poultry farmer, experience with poultry disease including HPAI, farmer age and education and understanding of biosecurity and the potential benefits, attitude to risk; management and marketing

systems; resource, information and capital availability; and the importance of poultry as an income source (Sri *et al.*, 2011). Similar factors were found in Ekiti State of Nigeria (Ajewole *et al.*, 2014). These were;- the level of education, formal training in poultry production, farm size and number of extension visits received, age and household labour size. Other constraints to adoption of biosecurity measures highlighted in the past research reports (Conan *et al.*, 2012) were financial constraints in a resource-poor setting. Biosecurity measures are often costly and may not be adapted to the economic considerations inherent to backyard poultry.

From the above literature it is evident that, there are many challenges facing indigenous chicken production including and not limited to, diseases and parasites, predator menace, cost of chicken feeds, socio-economic and socio-cultural issues, infrastructural and technical aspects. Adoption of biosecurity is still low in many African countries including Kenya and indigenous chicken productivity is generally on the decrease. This raised the need to conduct a study by collection of primary data from the IC producers to establish the gaps in indigenous chicken production and recommend possible interventions. The collected data was analysed using computer programmes such as; Microsoft Excel 2010, Statistical Package for Social Sciences (SPSS) and Chi-square to measure the discrepancies between the "observed" and the "expected" frequencies. At $p < 0.005$ it will be determined whether a given variable has any significant influence on another or not.

2.9 The conceptual framework

The conceptual framework is that low productivity of indigenous chicken in Kikumini/Muvau and Kithungo/Kitundu wards is due to constraints affecting this enterprise, inadequate biosecurity measures taken and socio-economic and ecological factors. If interventions are undertaken to handle these factors and adoption of biosecurity measures is enhanced at farm level, productivity of indigenous chicken in Makueni can be improved (Figure 2.1).

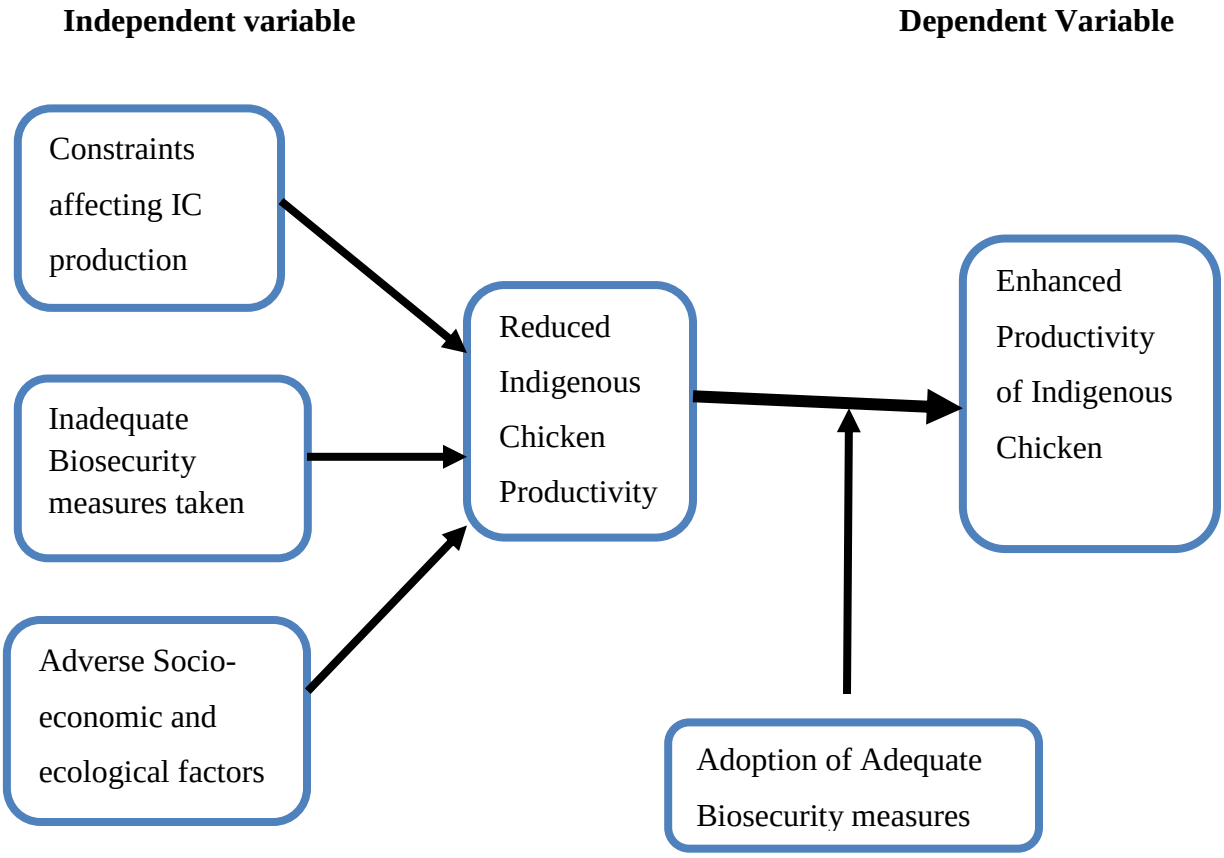


Figure 2.1: Conceptual frame work

CHAPTER THREE

3.0 METHODOLOGY

3.1 Study area

3.1.1 Background Information of Makueni County

Makueni County is located in South Eastern Kenya (Figure 3.1). It covers an area of 8,034.7 Km^2 and is one of the forty seven (47) counties in Kenya. The County borders Kajiado County to the West, Taita Taveta County to the South, Kitui County to the East and Machakos County to the North. It lies between Latitude 1º 35´ and 3º 00´ South and Longitude 37º10´ and 38º 30´East.

During the 2009 Population census, Makueni had 883,671 people with a growth rate of 2.4% p.a. In the year 2015 the population in the county had grown to 961,738, (468,298 males and 493,440 females) and is projected to rise to 1,116,136 by 2025 (Makueni County Agriculture Profile, 2015). The County lies in agro-ecological zone UM3 (Marginal coffee zone) to LM5 (Livestock-millet zone) (Jaetzold *et al*, 2006). The major physical features in Makueni County include the volcanic Chyulu hills which lie along the southwest border of the County in Kibwezi West Constituency, Mbooni Hills in Mbooni Constituency and Kilungu and Iuani Hills in Kaiti Constituency. Mbooni Hills rise to 1,900m above sea level. The County terrain is generally low-lying from 600m above sea level in Tsavo at the southern end of the county.

Table 3.1 : Administrative and elective units and their population

Constituency	S/NO.	Wards	Area (km^2)	Population 2009 census	House holds	Farm families
Mbooni	1	Tulimani	126	35350	5892	5597
	2	Mbooni	64	33774	5629	5348
	3	Kithungo/Kitundu	78	28185	4698	4463
	4	Kisau/Kiteta	176	37059	6177	5868
	5	Kako/Waia	176	23082	3847	3655
	6	Kalawa	330	27174	4529	4303
Kibwezi East	1	Thange	407	31654	5276	5012
	2	Masongaleni	482	32270	5378	5109
	3	Nzambani/Ivingoni	556	33442	5574	5295
	4	Mtito Andei	918	34354	5726	5439
Kibwezi West	1	Mulala/Emali	115	25657	4276	4062
	2	Nguu/Masimba	349	23764	3961	3763
	3	Makindu	638	42094	7016	6665
	4	Nguumo	469	28208	4701	4466
	5	Kikumbulyu South	232	26368	4395	4175
	6	Kikumbulyu North	285	20314	3386	3216
Kilome	1	Kiima Kiu/ Kalanzoni	272	22991	3832	3640
	2	Mukaa	101	26525	4421	4200
	3	Kasikeu	268	38348	6391	6072
Kaiti	1	Kee	82	26649	4442	4219
	2	Kilungu	73	33952	5659	5376
	3	Ilima	84	21025	3504	3329
	4	Ukia	184	38490	6415	6094

Makueni	1	Mbitini	116	30348	5058	4805
	2	Nzaui/Kalamba/Kilili	198	37042	6174	5865
	3	Kikumini/Muvau	231	24477	4080	3876
	4	Kathonzweni	301	31277	5213	4952
	5	Mavindini	259	23274	3879	3685
	6	Kitise/Kithuki	323	22054	3676	3492
	7	Wote	119	25326	4221	4010
			8012	**884527**	**147421**	**140050**

(*Source*: Makueni CIDP 2013-2017). Note: *Highlighted wards were the study sites*

Figure 3.1: Location of the Makueni County in Kenya. (*Source*: KNBS)

3.1.2 Climatic condition

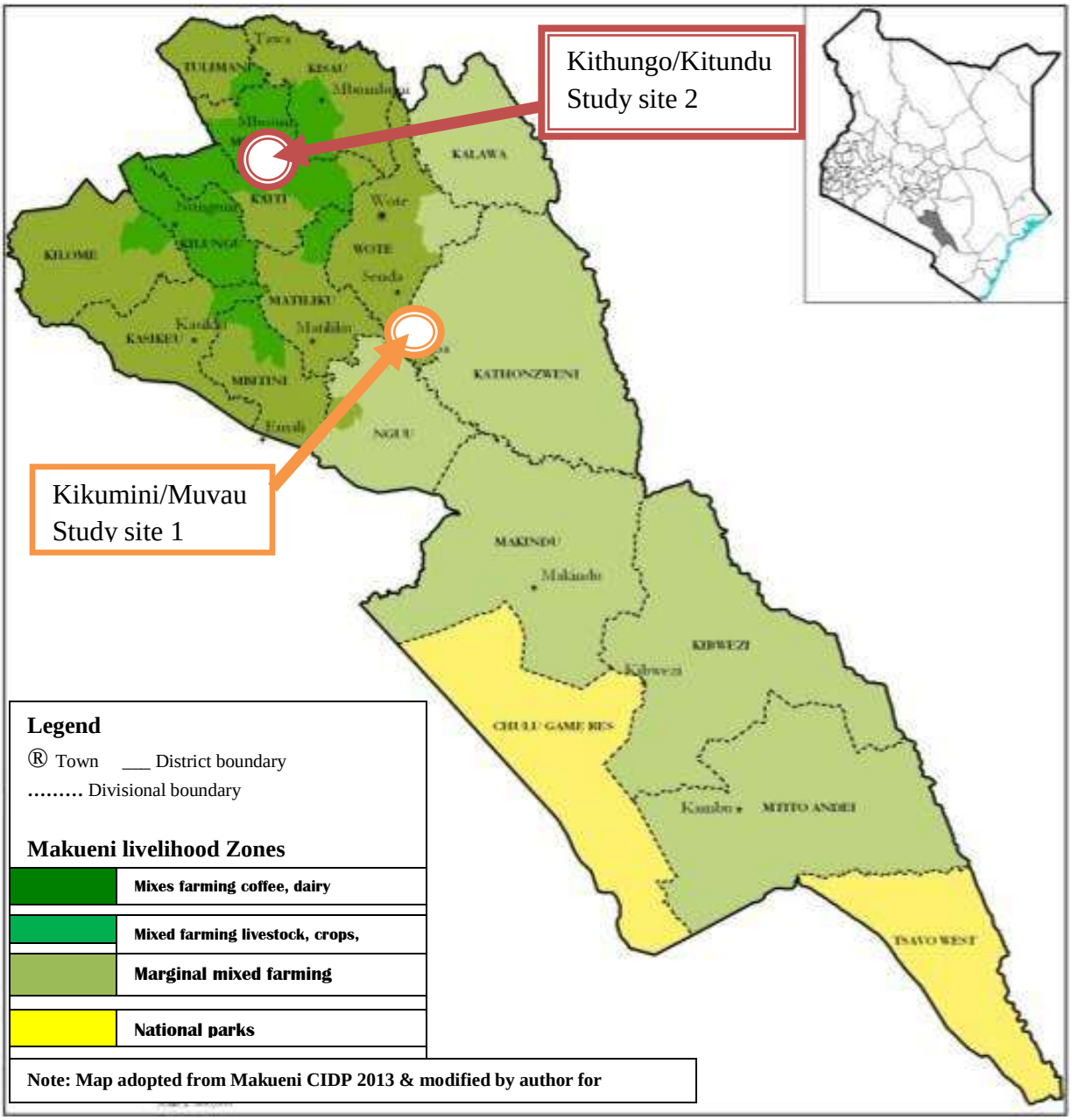
The county experiences bimodal rainfall annually averaging between 300 mm-1300 mm per year across the Agro-Ecological Zones. Rainfall is concentrated in two seasons, March-May and October-December (Jaetzold *et al.*, 2006) with the October-December rains being more reliable for crop production. Temperatures range from 20^{o} C to 32^{o}C, with the hilly masses going as low as 12^{o}C during the months of June and July. Relative humidity ranges from 30% to 80%.

3.1.3 Agriculture

Agriculture is predominantly mixed with both crop farming and livestock rearing. Crops are grown under rain-fed condition although in some pockets in Kibwezi East, Kibwezi West and the hill masses of Kilungu and Mbooni, small-scale irrigation is practised. The main crops produced in the County are maize, green grams, pigeon peas, cow peas, beans and sorghum. Mangoes paw paws and oranges are also produced as high value crops. Grafted mangoes have specifically become popular because the County has prioritised it as one of the priority value chains. Agricultural Sector Development Support Programme (ASDSP) has also invested a lot in promoting this crop in the County. Farmers in Makueni County keep a variety of livestock including cattle, poultry, goats and sheep. Small-scale beekeeping is practised where individual farmers own few hives such as Langstroth, Kenya Top Bar Hives (KTBH) and the traditional log hives. Beekeeping is mostly practise in the lower zones of the County. Ruminant species which were originally kept collectively in ranches are now mostly individually owned since most ranches have been sub-divided. The livestock sub-sector provides adequate supply of most animal products to meet domestic needs and surplus for export outside the county. In Makueni, the capital value of livestock is worth Ksh. 10.8 billion (CDA, 2013). According to livestock census of 2015, the county had an estimated population of 256,167 cattle, 115,011 sheep, 675,045 goats, 2040 camel, 965,475 poultry including turkeys (DALF, 2015). Others include 12,073 beehives, 1,831 rabbits, 60,027 donkeys 125,706 dogs. The livestock sub-sector is constrained by; droughts, diseases, lack of value addition,

inaccessible breeding materials (expensive breeding bulls and artificial insemination services), animal nutrition and underdeveloped infrastructure. The total area under cash and food crop is 23,356 Ha and 65,453 Ha respectively which is 2.9 per cent and 8.1 per cent respectively of the total County area (Makueni CIDP, 2013). The average farm size is 3.44 acres for small holder farmers and 30.4 acres for large-scale farmers.

Figure 3.2: The Livelihood zones in Makueni County (*Source*: Makueni CIDP 2013)



3.1.4 Livelihood zones

Makueni County can be classified into three main livelihood zones as shown below: -

1. Mixed farming (MF) coffee/dairy/irrigated farming with 20% human population.
2. Mixed farming (MF) food crops, cotton and livestock zone with 31% population.
3. Marginal mixed farming (MMF) cotton and meat livestock zone with 49% population (Fig. 3.2) above.

3.1.5 Selected Study site

The study was conducted in Kikumini/Muvau ward in Makueni sub-County and Kithungo/Kitundu ward in Mbooni sub-County. Kikumini/Muvau ward is in LM 4 where mixed crop-livestock production system abounds (MCCU-SP, 2012). The ward is mainly arid and experiences prolonged droughts from time to time characterized by extreme rainfall variability. Crops grown in Kikumini/Muvau include drought tolerant crops like cow peas, green grams and pigeon peas. Livestock kept includes Zebu cattle, dairy crosses, meat goats, local sheep and indigenous chicken. Kithungo/Kitundu ward is situtaed in UM 3 and is slightly wetter than Kikumini/Muvau. Crops grown in Kithungo/Kitundu include maize, beans for subsistence, while in some pockets coffee is grown as cash crop. Cattle including dairy crosses and meat and dairy goats, indigenous and improved commercial chicken are reared in Kithungo/kitundu ward. Dairy farming is slowly taking root in this ward.

3.1.6 Study sites selection procedure and criteria

The study areas (sites) were purposively selected to represent the dry and wet Agro-ecological zones and the major livelihoods found in Makueni county. Simple random sampling was used to select the study ward out of six in Mbooni sub-county and one out of ten in Makueni sub-county.

1. Livelihood and Agro-ecological zoning;-Kikumini/Muvau ward represented marginal mixed farming zone (LM4) which has 20% of the County's population

while Kithungo/Kitundu ward represented mixed farming-coffee, dairy and irrigation zone (UM3) with 31% of the population.

2. Concentration of agricultural production activities;- Normally crops and livestock perform comparatively better in UM 3 and LM 4 than in the other Agro-ecological zone. The sites are conducive for production of raw materials that make the bulk of indigenous chcicken feeds.
3. Heavy investments;- in chicken enterprise in both sites in terms of distribution of indigenous chicken breeding stock and incubators by the Makueni County gorvernment and other development agencies, with no improvement in productivity and output of marketable birds.

Small holder chicken producers for the purpose of this study were those with a farm size (1-10 Acres), and the flock size (less than 120 birds). Kikumini/Muvau ward is one of the nine wards that make up Makueni Sub-county, others being; Wote, Mavindini, Kitise/Kithuki, Kathonzweni, Nguu/Masumba, Nziu/Kilili/Kalamba, Mbitini and Emali/Mulala wards. The ward covers 231.1 Sq Km and has a population of 4080 people (KNBS, 2010). Figure 3.3 below shows the location of the study site 1-Kikumini/Muvau ward.

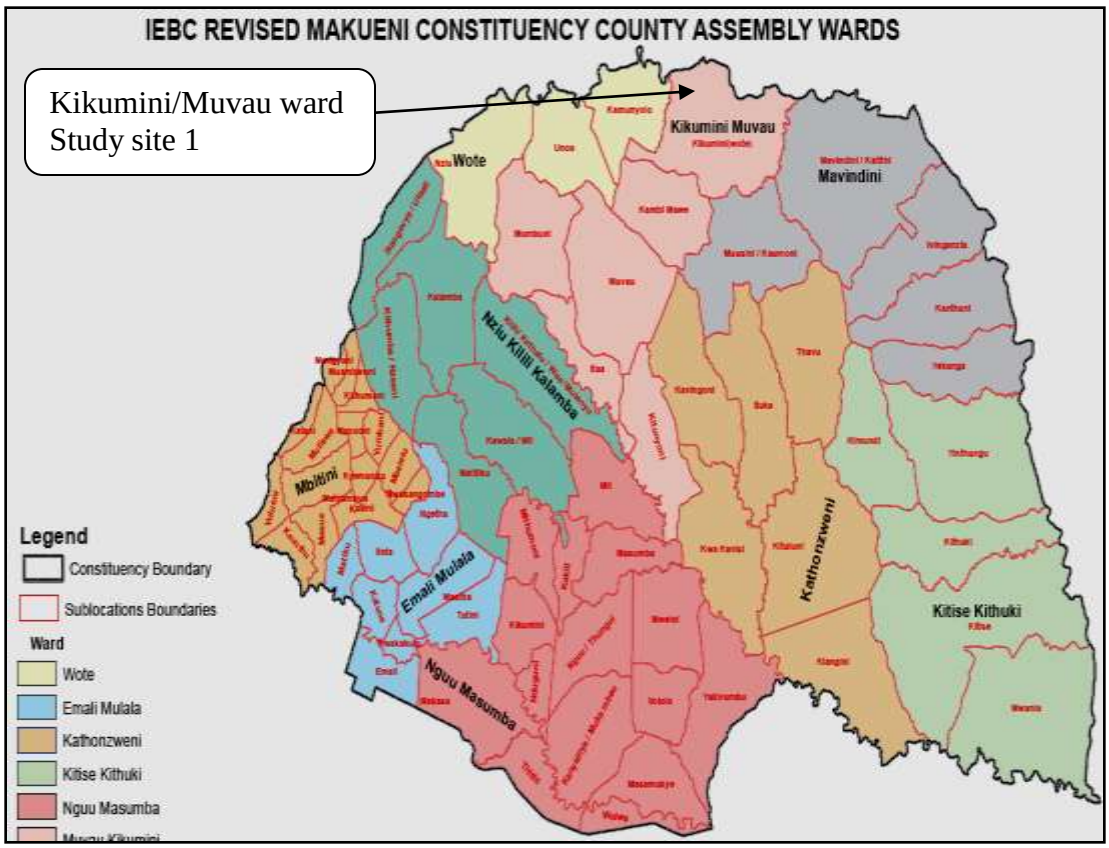


Figure 3.3: Makueni Sub-County *(Source*; Makueni County government profile 2013).

Kithungo/Kitundu ward is in Mbooni Sub-County and is one of the six wards in this sub-county. Other wards are Tulimani, Mbooni, Kiteta/Kisau, Waia/Kako and Kalawa. Kithungo/Kitundu covers 77.7 Sq Km and has 4698 people. Figure 3.4 shows study site 2, -Kithungo/Kitundu ward.

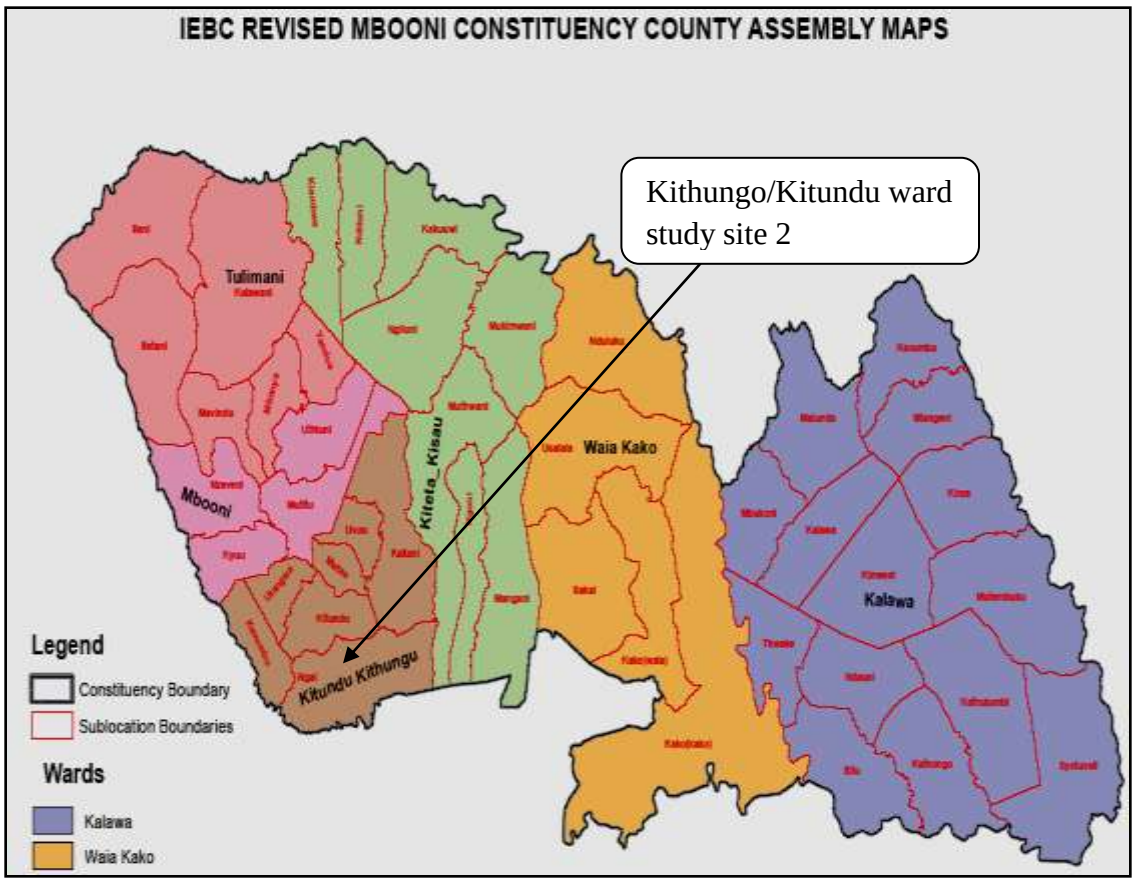


Figure 3.4: Mbooni Sub-County *(Source*: Makueni County government profile 2013)

3.2 House hold sample size determination

The study households were selected through probablistic simple random sampling (Dohoo *et al*., 2003) and using the formulae: $n=Z^2_{\alpha}\, p.\, (1-p)/L^2$,

Where, n =sample size needed; $Z_{\alpha} = Z_{0.05} = 1.96$; L = the precision of the estimate (allowable error or margin of error =5%). Thus $L^2 =0.0025$ or, *p*= priori proportion (0.75) since 75% of rural households in Kenya keep indigenous chicken (Nyaga, 2007 b). The predicted value of p where the margin of error is 0.05 is $0<p<1$.

Thus $n= (1.96)^2 \times (0.75) \times 0.25/0.0025= 288$.

3.3 Sampling design

The two Sub-Counties (Makueni and Mbooni) were selected though stratified random sampling ("in order to obtain a representative sample" Kothari, 2004) out of the six sub-counties forming the Makueni County. The two wards were selected through simple randomly sampling (Kothari, 2004) to represent each zone; – Kithungo/Kitundu from the six wards forming Mbooni sub-county and Kikumini/Muvau from the nine wards that form Makueni sub-county.

The 288 households were randomly selected (from a source list) (Kothari 2004), provided by the chiefs of the two sites. All the 2008 house hold names and 2340 household names provided by the respective chiefs were assigned numeric numbers in small folded papers. The folded papers were picked from the carton without replacement, and with shaking of the carton after every pick.

3.4 Data collection

3.4.1 Primary data

Primary data was collected at the grassroot (community) level through focussed group discussions and household survey.

3.4.1.1 Focused group discussion

Two focussed group discussions were conducted within the proximity of the selected HHs in both Kikumini/Muvau and Kithungo/Kitundu wards .Participants in the FGDs were farmers from the households that fall under the category of small-holder, and had not been interviewed during househols surveys. In Kikumini/Muvau, 17 farmers (9 males and 8 females) participated in FGD while, in Kithungo/Kitundu FGD, 16 farmers (11 males and 5 females) participated in the FGDs. The FGDs were conducted using a pre-developed checklist to collect data on the general perception of the community on trends in the productivity of IC in the study area. Also to check the possible socio-economic

and ecological factors that could be hindering adoption of biosecurity measures that have been disseminated to the IC producers and their suggested solution.

3.4.1.2 Household survey

This study interviewed 158 individual households (HHs) selected in both study wards Kikumini/Muvau and Kithungo/Kitundu. A combination of structured and semi-structured questionnaire which was developed and pretested was used during the household survey. The questionnaire collected data on;- i) general information of the respondent and the household status, ii) constraints that affect the productivity of indigenous chicken in the study area, iii) biosecurity measures practised in the study area and iv) the socio-economic and ecological factors that hinder the adoption of biosecurity measures in the study area. The questionnaire was administered to the house hold head or his/her representative of sound mind.

3.5 Data Analysis and presentation

Data collected were cleaned, coded and analysed using both MS Excel 2010 and Statistical Package for Social Sciences (SPSS) version 17.0 data analysis software. The first analysis involved respondents' general information. The next analysis focused on each specific objective in an attempt to answer the research questions.

Descriptive statistical tools (Kothari, 2004) for frequencies, percentages, means, dispersion, distribution and cross tabulation were used during analysis. Chi-square statistics was also conducted to measure the discrepancies between the "observed" and the "expected" frequencies. The data findings were interpreted with support of other documented research findings available in hard and soft documents. A composite score was computed to aid in discussing the analyses. The composite score was derived by adding strongly agree and agree to form one score (Has affected) while strongly disagree and disagree formed another score (Has not affected). This is in response to questions

seeking committal answers from respondents. The non-committal responses were not factored in the composite score and hence were ignored.

CHAPTER FOUR

4.0 RESULTS

4.1 Results of household survey

4.1.1 Response Rate

After cleaning, 143 questionnaires were found valid for analysis. This accounted for 84.1% response rate.

4.1.2 Household Background Information

The background information sought included; head of household, size of household, size of land, gender among others as discussed in sections below. House hold for this study refers to members who share meals from the same kitchen, in a homestead there can be several households.

Majority (46.2%) of the respondents in the study HHs were adult females and were followed closely by adult males at 39.9% (Table 4.1). The other respondents included female youths at 7.7% and male youths at 3.5%.

Table 4.1: Position of the respondents in household

	Frequency	Percent	Valid Percent
Wife	66	46	47.5
Husband	57	40	41.0
Daughter	11	7.7	7.9
Son	5	3.5	3.6
Total	139	97.2	100.0

Most households in the study area were male headed at 72.7%, while 19.6% were female headed. However there were some 2.1% and 1.4% headed by male child and female child respectively (Table 4.2).

Table 4.2: Head of the household

Household head	Frequency	Percent	Valid Percent	Cumulative Percent
Male headed	104	72.7	75.9	**75.9**
Female headed	28	19.6	20.4	**96.4**
Male child headed	3	2.1	2.2	**98.5**
Female child headed	2	1.4	1.5	**100.0**
Total	**137**	**95.8**	100	

The study found the largest family had 19 members and the smallest with only 1 person. On average there are about six (6) members while most of the households have four members composed of three (3) adults (two males and one female) and three (3) children (1 boy and 2 girls). The second adult male was mostly an employed worker.

In terms of age, the study found that majority (84%) were over 55years and, 12% were between 21 and 54 years. The youngest respondents (3%) were aged 20 years while the oldest (1%) were aged 92 years. The study found that 85.4% of the respondents have attained basic education with the highest percentage (39.9%) having attained the primary level of education and 28% having completed secondary level education (Figure 4.1).

For respondents' occupation, the study found that majority (34.6%) in Kithungo/Kitundu depended on sale of produce from crops, 22.2% sale on livestock and livestock products,18.5% on small scale businesses while some 14.8% depended on formal employment. However, few respondents (9.9%) depended on remittances from working children, government and other relatives. A similar trend was indicated in Kikumini/Muvau where 30.6% relied on sale of crops, 27.4% sale of livestock, 19.4% and 14.5% relied on small scale businesses and formal employment respectively. Only 8.1% in this ward depended on remittances (Table 4.3). Those relying on remittances are

the elderly persons (over 65 years) who due to age and ailments cannot fend for their needs and those of their household members residing at the farm.

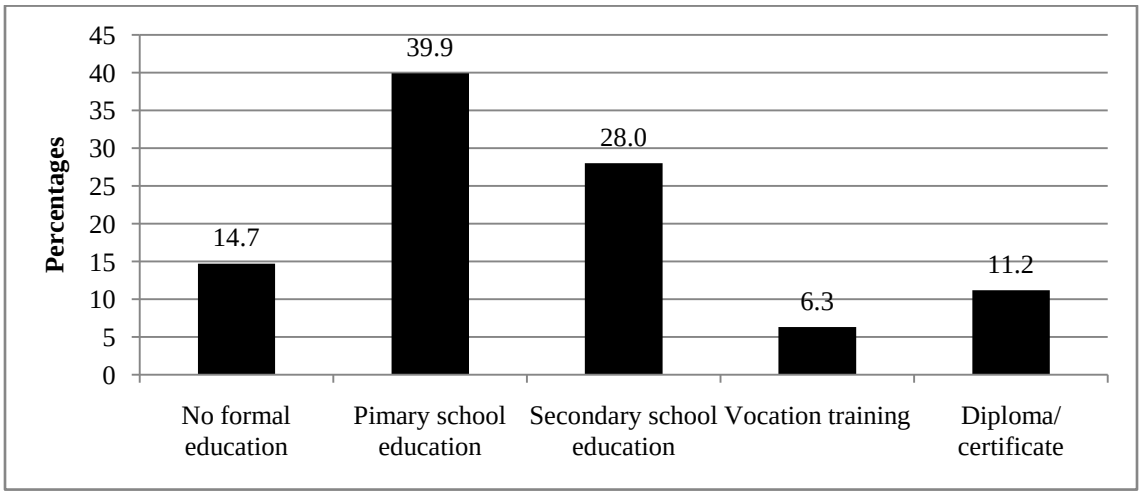


Figure 4.1: Levels of Education of Respondents

Table 4.3: Respondents Occupation

Respondents Occupation	**Kikumini/Muvau**		**Kithungo/Kitundu**	
	Response	Per cent	Response	Per cent
Sale of crops produce	19	30.6	28	34.6
Sale of livestock/products	17	27.4	18	22.2
Business	12	19.4	15	18.5
Formal employment	9	14.5	12	14.8
Remittances	5	8.1	8	9.9
Total	**62**	**100.0**	**81**	**100.0**

The smallest land size owned by interviewed respondents was 0.5acre while the largest was 110 acres. Kithungo/Kitundu ward has the smaller land sizes ranging from 0.5 acres to15 acres, the average being 5 acres. In Kikumini/Muvau ward the land size is comparatively larger ranging from 2 acres to 110acres, with an average of 10 acres.

4.1.3 Livestock and Poultry

Farmers reared cattle, goats, sheep and mixed breeds of chicken. Indigenous chicken were most predominant (89.5%) followed closely by goats (74.1 %,) sheep (67.8%) and cattle (62.9%) (Figure 4.2).

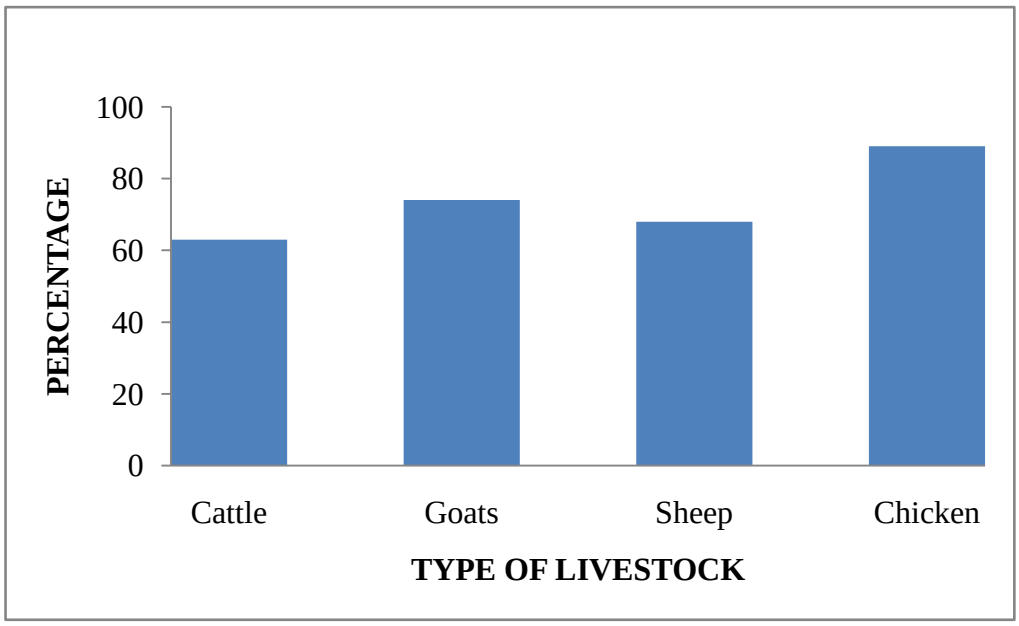


Figure 4.2: Type of Livestock kept

Overall, households in the study wards owned on average 19 chickens, 3 cattle, 3 goats and 1 sheep.

Table 4.4: Average number of Livestock per HH by study ward

	Kikumini/Muvau	Kithungo/Kitundu
Number chicken	20	12
Number of cattle	5	3
Number of goats	10	4
Number of sheep	2	3

4.1.4 Breeds of Livestock kept

Majority of the respondents preferred local livestock breeds with indigenous chicken being the most preferred (96.5%), closely followed by local sheep (89.5%) with local goats breeds being the least at (71.4%) (Figure 4.3). Crossbred goats and exotic chicken were the least kept at 1% and 0.9% respectively. No respondents kept cross breed sheep.

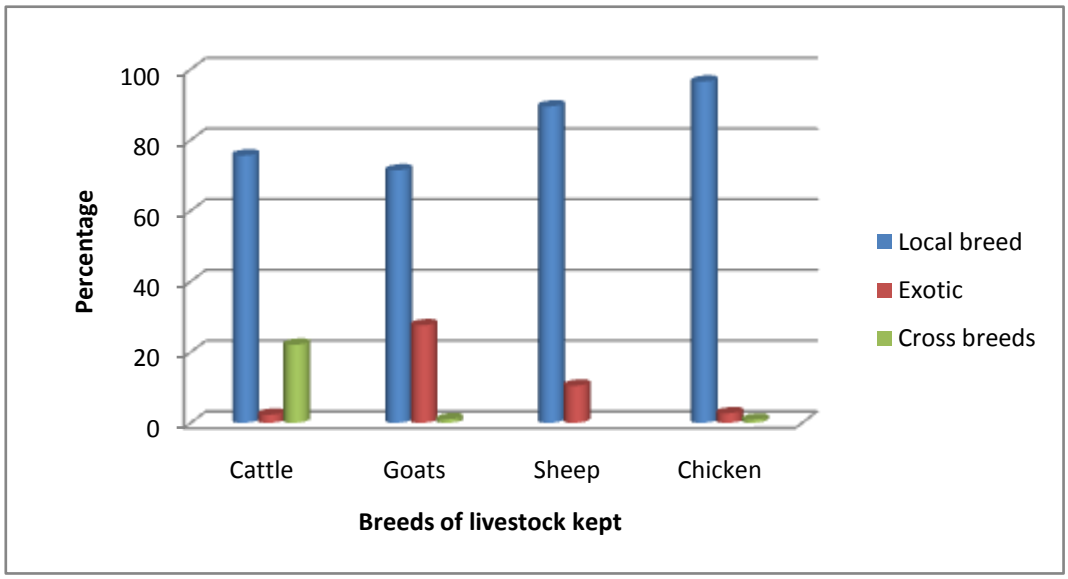


Figure 4.3: Breeds of Livestock kept

4.1.5 Flock structure of chicken kept

Respondents had varied chicken flock structure composed of a mixture of chicks, growers, hens and cocks (Table 4.5). In some households, it was observed that growers

were the majority followed by hens and chicks. Cocks were the least with a ratio of 1:4 for cocks to hens.

The survey found that the least experience of keeping indigenous chicken was one year while the longest was 69 years. The findings also established that the average experience was 19 years while most of them had an experience of 20 years.

Table 4.5: Flock structure of chicken kept

	Cocks	Hen	Chicks	Growers	Pullets
Minimum	1	1	1	1	1
Maximum	6	25	22	383	15
Mean	2	5	8	11	4
Mode	1	2	4	2	2

4.1.6 Reasons for keeping Indigenous chicken

Majority (75.2%) and (64.5%) of households in Kikumini/Muvau and Kithungo/Kitundu respectively reared chicken for subsistence (provision of family food) whereas 20.6% in Kikumini/Muvau and 27.8% in Kithungo/Kitundu reported that their chicken were for earning household income. A small proportion (7.7%) and (4.2%) in Kithungo/Kitundu and Kikumini/Muvau respectively reared chicken to produce eggs for hatcheries (Figure 4.4).

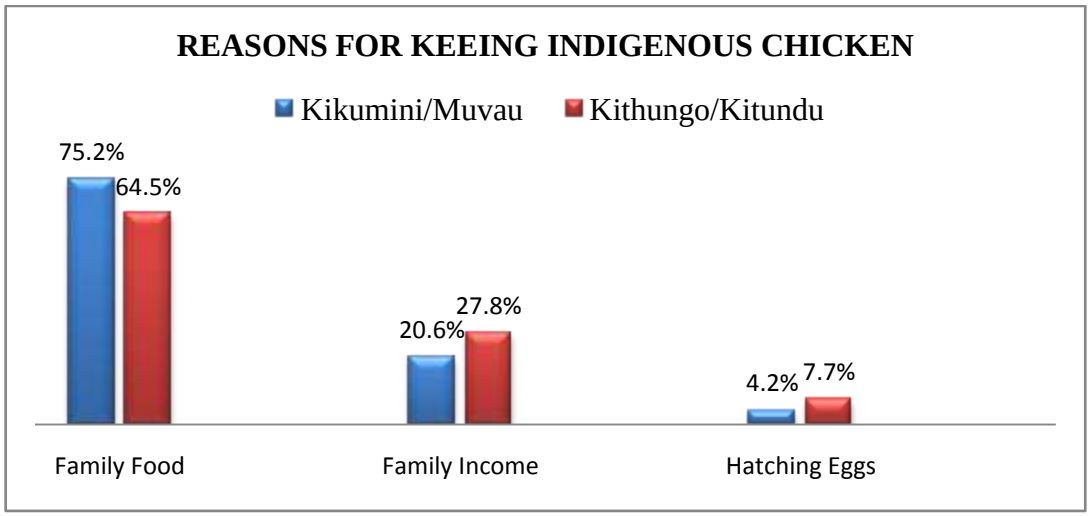


Figure 4.4: Reasons for Keeping Indigenous chicken

4.1.7 Method of raising chicken

Free range was the most preferred chicken rearing system as it was reported by majority (74.1%) of the households interviewed. This was followed by semi-free range system at 22.4% with paltry 3.5% rearing chicken under the intensive production (Figure 4.5).

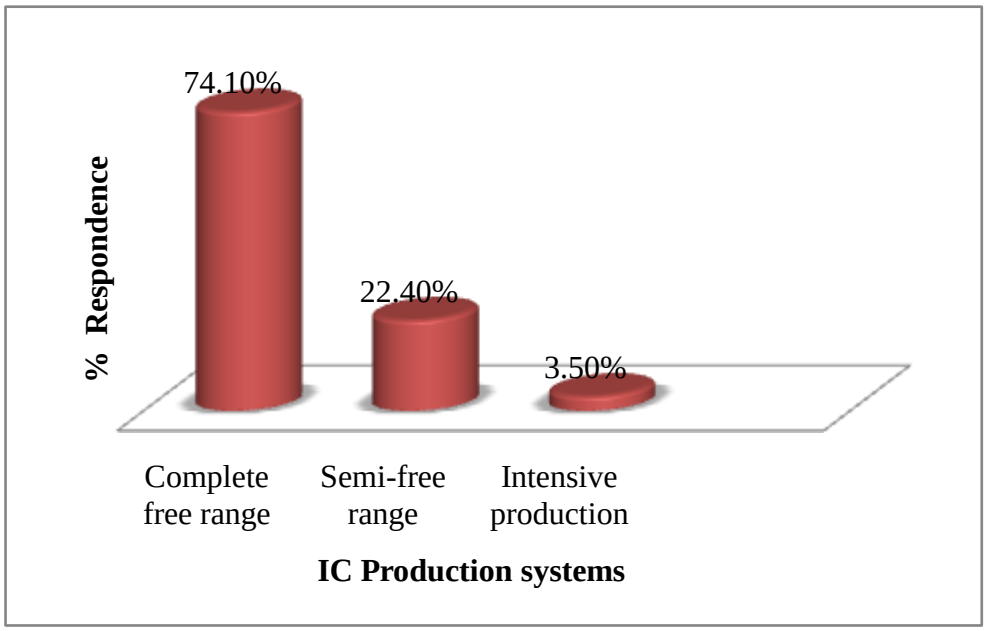


Figure 4.5: Method of raising chicken

4.1.8 Challenges faced when rearing indigenous chicken

The major challenges facing chicken rearing in the two study wards were diseases, parasites, predators, and inadequate feeds (Table 4.6). Other constraints noted were lack of proper chicken housing, conflict with neighbours, low chicken husbandry skills, low returns from chickens, theft and rat menace.

New castle disease (NCD) was identified as the main disease condition that affect chicken productivity, closely followed by Infectious Bursal Disease (Gumboro), fowl pox, Coccidiosis and respiratory diseases (Figure 4.6). The other disease conditions were leg paralysis (Mareks) and a host of undefined disease conditions.

Table 4.6: Challenges faced when rearing indigenous chicken in both study wards

Challenges	**Kikumini/Muvau**		**Kithungo/Kitundu**	
	Freq.	**%**	**Freq.**	**%**
Predators attacks	124	28.3	93	21.6
Diseases	112	25.5	120	27.9
High cost of feeds	60	13.7	79	18.4
Parasites attack	35	7.9	39	9.1
Lack of proper chicken housing	30	6.8	24	5.6
Lack of chicken husbandry skills	30	6.8	20	4.6
Small returns	18	4.1	7	1.6
Theft	17	3.9	21	4.9
Conflict with neighbours	9	2.1	25	5.8
Rats	3	0.7	2	0.5
Total	**438**	**100.0**	**430**	**100.0**

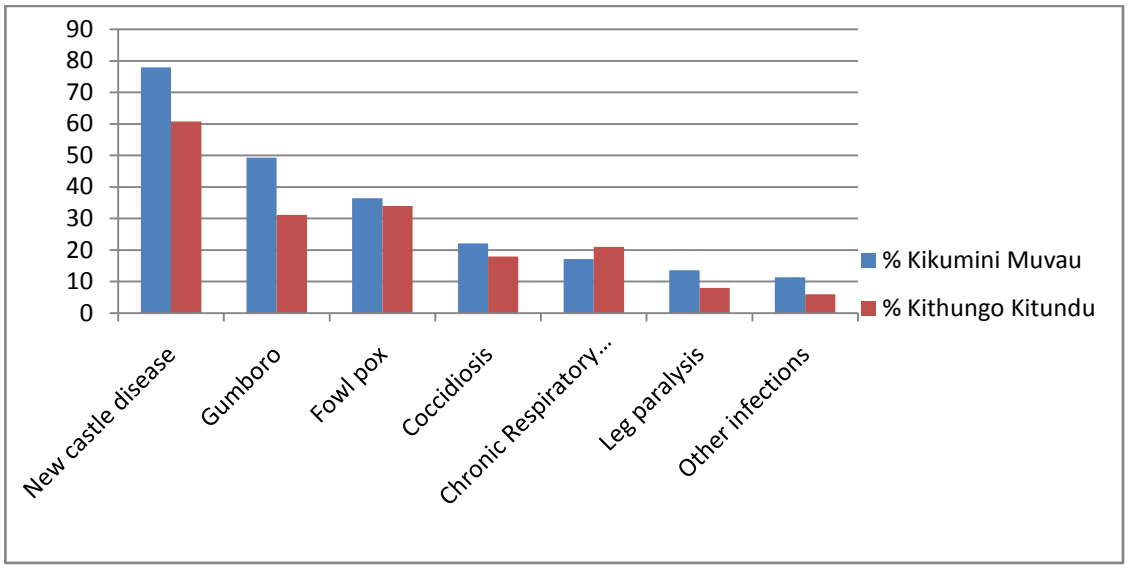


Figure 4.6: Chicken diseases experienced in the study sites

Table 4.7: χ^2 on constraints faced when in indigenous chicken production in both study wards

Challenge	Kikumini/Muvau			Kithungo/Kitundu			p-value	Row Totals
	F (Observed variables)	Expected cell totals	chi-square statistic for each cell.	F (Observed variables)	Expected cell totals	chi-square statistic for each cell.		
Predators attacks	124	109.50	1.92	93	107.50	1.96	0.10150	217
Diseases	112	117.07	0.22	120	114.93	0.22	0.10082	232
High cost of feeds	60	70.14	1.47	79	68.86	1.49	0.10070	139
Parasites attack	35	37.34	0.15	39	36.66	0.15	0.10090	74
Others	107	103.95	0.09	99	102.05	0.09	0.10090	206
Column Totals	438			430				868 (Grand Total)
The chi-square statistic is 7.7554. The p-value is 0.100961. The result is not significant at $p < 0.05$								

When subjected to chi-square statistics, constraints facing indigenous chicken production at $p < 0.05$, were not significantly influencing the adoption of biosecurity measures in the two study sites (Table 4.7 above).

4.1.9 Management of Chicken Diseases

Farmers managed chicken diseases through treatments using ethno-veterinary and conventional veterinary drugs, vaccination and selling the flocks to evade disease outbreaks (Table 4.8). Some of the herbs used to treat chicken diseases were aloe, Mexican marigold, black jack leaves, croton roots, star grass leaves, and hot pepper. Treatment using herbs was the most preferred method of responding to disease outbreaks in Kikumini/Muvau ward (43.3%) while in Kithungo/Kitundu 54% administered the drugs themselves and 42% in the same ward used herbs. Some respondents did administering of treatments, while others called veterinary professionals. Other methods of responding to disease outbreaks included slaughtering the birds for home consumption.

Table 4.8: Management of chicken diseases

Disease management practice	**Kikumini/Muvau % x/n**		**Kithungo/Kitundu %x/n**	
	Response	**Per cent**	**Response**	**Percent**
Treatment using herbs	65	43.3	42	28.4
Self-administer veterinary drugs	29	19.3	54	36.5
Vaccination	27	19	30	20.2
Call veterinary officer	20	13.3	17	11.5
Selling mildly affected chicken	4	2.7	2	1.4
Give affected chicken to pets	4	2.7	1	0.7
Do nothing	1	0.7	2	1.3
Total	**150**	**100.0**	**148**	**100.0**

The respondents reported using a variety of parasite control strategies in the two study wards of Kikumini/Muvau and Kithungo/Kitundu. Use of parasite dusting powders and regular cleaning of poultry housing units were the two most preferred and practised

methods used (Figure 4.7). Other methods used to control parasites include use of wood ash, use of motor oil, detergents, splashing water and acaricides.

4.1.10 Training on Chicken Management

Trainings on chicken management skills were still inadequate in the two study wards as shown by the huge proportion of farmers who had not been trained on basic poultry husbandry practices (Figure 4.8).

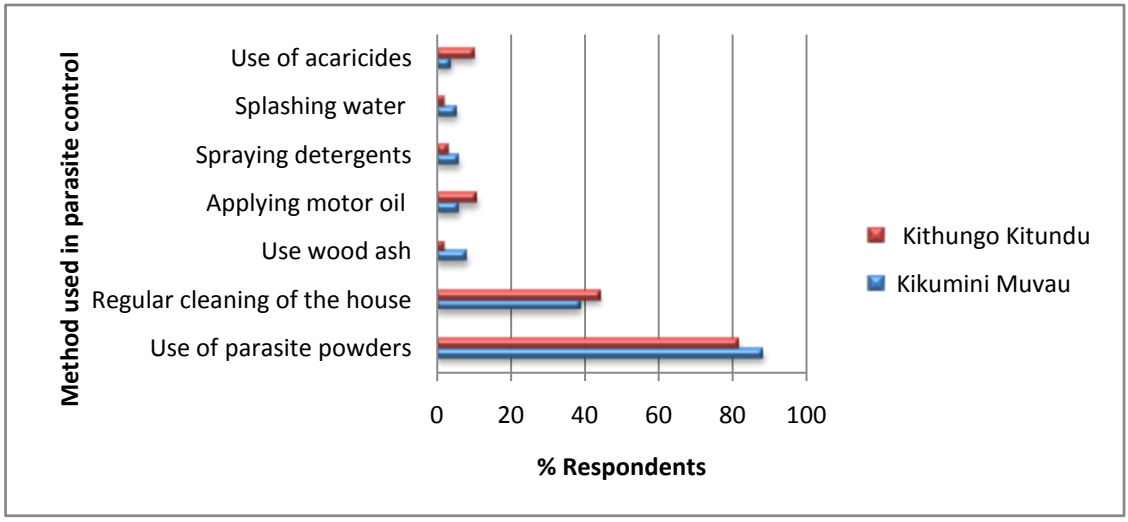


Figure 4.7: Parasitic infestations management

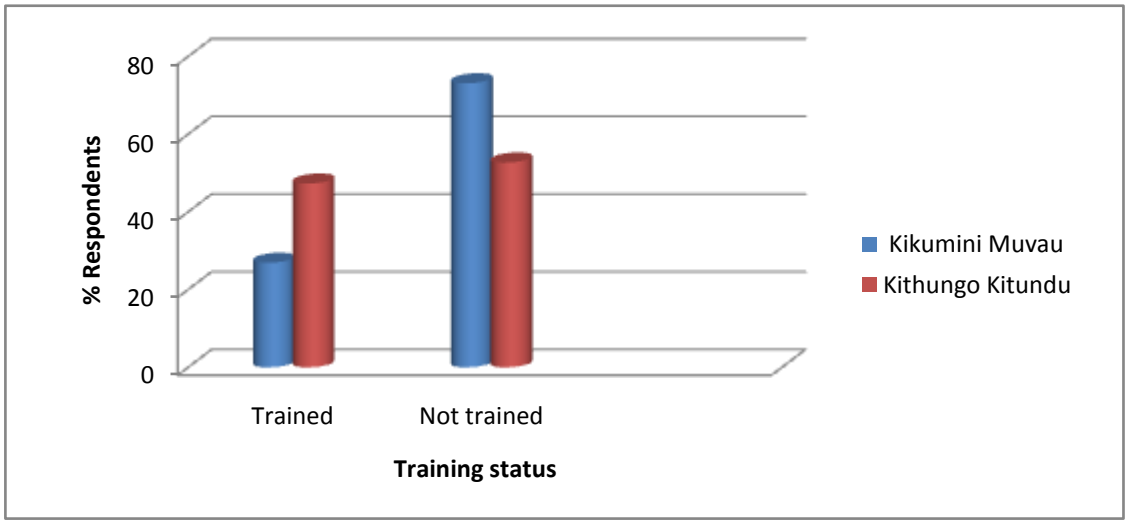


Figure 4.8: Training on Chicken Management

More training was conducted in 2015 followed by 2013 (Figure 4.9). Less training was done in 2016.

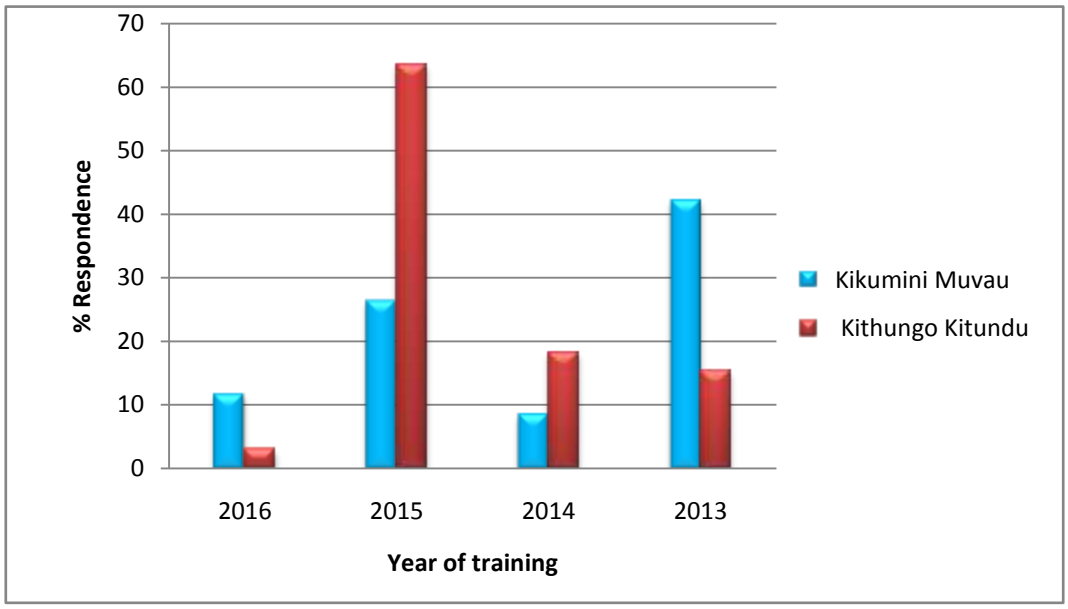


Figure 4.9: Frequency of Training

The trainings on improved poultry management were facilitated by KALRO through the KALRO/McGill University food security project that operated in Makueni sub-county between 2013 and 2015, the Climate Change Agriculture and Food Security (CCAFS) project which operated in the Kikumini/Muvau ward in 2013 and 2014 and the government of Makueni County in 2015 and 2016 prior to the distribution of improved indigenous chicken in Kithungo/Kitundu ward. More females than males in both study wards benefitted from the training (Table 4.9).

Table 4.9: Cross tabulation between household members trained and how they benefited

Response	**Kikumini/Muvau ward**		**Kithungo/Kitundu ward**	
	Males %	Females %	Males %	Females %
Benefitted	24.2% (15/62)	41.9% (26/62)	24.7% (20/81)	49.4% (40/81)
Did not benefit	14.5% (9/62)	19.4% (12/62)	18.5% (15/81)	7.4% (6/81)

4.1.11 Extension Services for chicken Production

The study found that chicken farmers in both wards accessed extension services through government workers mostly. However respondents in Kikumini/Muvau received slightly higher services than those in Kithungo/Kitundu (Table 4.10). Agricultural extension services in these wards were also provided by private professionals, community based service providers, Faith Based Organizations (FBOs) and non-governmental organizations. Agricultural information to the farmers was mostly received via radio and television programmes, Field days, agricultural shows, public *Barazas* and occasionally farm visits were used to extend agricultural information. A smaller number accessed information through farmer field schools and written materials. In both wards majority of respondents were satisfied with chicken production extension services received.

The delivery of the extension services on chicken management in both study wards was hindered by the solutions offered not matching the chicken farming challenges low value attached to chickens and low literacy levels (Table 4.11). Other challenges to the poor reception of extension services delivered included language of delivery, costly extension materials and trainings that are attended by audience (mostly men) who in most cases were not real daily care takers of chicken.

Table 4.10: Extension Services on chicken production

Extension Services		**Kikumini/Muvau**		**Kithungo/Kitundu**	
		N	**%**	**N**	**%**
A. Access to extension services	Yes	51	72.8	40	54.8
	No	19	27.2	33	45.2
	Total	**70**	**100.0**	**73**	**100.0**
B. Extension services provider	Community based service providers	11	17.5	12	25.4
	County DALF/GoK	32	50.8	23	48.8
	FBO's	6	9.5	4	8.5
	Trained professionals	10	15.9	6	13.0
	NGO's	4	6.3	2	4.3
	Total	**63**	**100.0**	**47**	**100.0**
C. Method used to provide extension message on chicken production	Listening to radio /TV programmes	36	48.0	21	31.0
	During field days	23	30.7	13	19.1
	Public Barazas	10	13.3	9	13.2
	During farm visits	3	4.0	17	25.0
	During FFS sessions	2	2.7	6	8.8
	Read written materials	1	1.3	2	2.9
	Total	**75**	**100.0**	**68**	**100.0**
D.Satisfaction with extension services provided	Yes	27	40.9	26	33.8
	No	39	59.1	51	66.2
	Total	**66**	**100.0**	**77**	**100.0**

NB: Variables B, C and D analysis was based on those who responded

Key: DALF/GoK=County Department of Agriculture, Livestock & Fisheries/ Government of Kenya; NGO's = Non-governmental Organisations; FBO's = Faith Based Organisations, FFS= Farmer Field School.

Table 4.11: Challenges to Receiving Extension services

	Kikumini/Muvau		Kithungo /Kitundu	
Challenges	**Frequency**	**Percent**	**Frequency**	**Percent**
The message not directed to problem at hand	24	36.4	31	43.1
Low value attached to IC	17	25.8	5	6.9
Low literacy level of farmers	15	22.7	11	15.3
Technical language used in extension	5	7.6	9	12.5
Costly dissemination material	3	4.5	5	6.9
The message not tailored for the care takers of chicken (women)	2	3.0	11	15.3
Total	**66**	**100.0**	**72**	**100.0**

4.1.12 Suggested solutions to the identified challenges

The respondents suggested various approaches to address the challenges identified to hinder delivery of extension services (Table 4.13). The main suggested solutions by respondents were to increase in government extension officers, training of more community based service providers, enhancement of marketing, and financial extension services. Other methods suggested were provision of improved chicken breeding stock, extension using farmer to farmer field schools, packaging of chicken extension materials in vernacular and construction of model chicken houses. A few respondents suggested availing vaccines near the farmers, increase in paravet services and supply of more written materials (pamphlets and brochures).

Table 4.12. χ^2 on method of provision of extension message on chicken production

Method used to provide extension message	Kikumini/Muvau			Kithungo/Kitundu			*p*-value	Row Totals
	F (Observed variables)	Expected cell totals	chi-square statistic for each cell.	F(Observed variables)	Expected cell totals	chi-square statistic for each cell.		
Listening to radio /TV programmes	36	29.90	1.25	21	27.10	1.38	0.00091	57
During field days/shows	23	18.88	0.90	13	17.12	0.99	0.00098	36
Public Barazas	10	9.97	0.00	9	9.03	0.00	0.00089	19
During farm visits by extension officers	3	10.49	5.35	17	9.51	5.90	0.00099	20
Others	3	5.77	1.33	8	5.23	1.47	0.000999	11
Column Totals	75			68				143 (Grand Total)
The chi-square statistic is 18.5523. The *p*-value is 0.000962. The result is significant at $p < 0.05$								

With chi-square statistics, at $p < 0.05$ Methods used to disseminate extension messages has significance influence on adoption of biosecurity (Table 4.12).

Table 4.13: Solution to Challenges of accessing Extension services

Respondents suggested solutions	Responses			
	Kikumini/Muvau		Kithungo/ Kitundu	
	Freq.	%	Freq.	%
Recruit more extension officers	39	26	20	14.1
Train more community service providers	27	18	40	28.2
Improve marketing & financial services	22	14.6	18	12.7
Provide improved chicken breeding stock	13	8.7	9	6.3
Extension using farmers to farmer field school	12	8	7	4.9
Package extension message in vernacular	10	6.7	5	3.5
Demonstrations on appropriate chicken housing	9	6	13	9.2
Avail vaccination and Para veterinary services	8	5.3	11	7.7
Chicken Specific extension interventions	3	2	17	12
Dissemination of extension messages using written materials (pamphlets/ brochures etc)	7	4.7	2	1.4
Total	**150**	**100.0**	**142**	**100.0**

4.1.13 Provision of supplementary feeds to indigenous chicken

Generally, birds in the study area are left to scavenge with occasional targeted supplementation. Majority (90.2%) of the respondents in Kikumini/Muvau and 87.4% in Kithungo/Kitundu supplemented their birds. Birds were supplemented with an assortment of feed materials, with whole grains sourced from own farms and kitchen left overs (Table 4.14). Commercial concentrates were also used as supplements by few respondents, although in some cases the commercial concentrates were mixed with grains

before being fed to the birds. Other supplements used in both study wards included, own home formulated rations, milling by-products, termites and vegetables.

Table 4.14: Types of feeds given to chicken

Supplement types used on chickens	**Responses**			
	Kikumini/Muvau		**Kithungo/Kitundu**	
	Freq.	**Percent**	**Freq.**	**Percent**
Grains from own farm	59	39.3	48	25.1
Kitchen leftovers	35	23.3	59	30.9
Mixing commercial feeds and grains	15	10	44	23
Formulate my poultry feed	21	14	11	5.8
Green vegetables	4	2.8	13	6.8
Commercial Concentrates	3	2	12	6.3
By products from millers (Bran)	8	5.3	2	1
Harvest termites	5	3.3	2	1
Total	**150**	**100.0**	**191**	**100.0**

Table 4.15: χ^2 on types of and safety of feeds given to chicken

Types of feeds	Kikumini/Muvau			Kithungo /Kitundu			p-value	Row Totals
	F (Observed variables)	Expected cell totals	chi-square statistic for each cell.	F (Observed variables)	Expected cell totals	chi-square statistic for each cell.		
Grains	59	46.40	3.42	48	60.60	2.62	0.000010	107
Left Overs	35	40.76	0.81	59	53.24	0.62	0.000012	94
Com Feeds	15	25.59	4.38	44	33.41	3.35	0.000010	59
Homemade Feeds	21	13.88	3.66	11	18.12	2.80	0.000011	32
Greens	4	7.37	1.54	13	9.63	1.18	0.000097	17
Column Totals	134			175				309 (Grand Total)
The chi-square statistic is 24.3917. The p-value is 0.0000679. The result is significant at $p < 0.05$								

The chi-square statistic is 24.3917. The p-value is 0.0000679. The result is significant at $p < 0.05$ this means that types and safety of feeds given to chicken is significant factor in influencing adoption of biosecurity measures amongst indigenous chicken producers in study area (Table 4.15).

4.1.14 Effects of indigenous chicken rearing constraints on productivity

The computed composite scores, 85.3% of respondents in Kikumini/Muvau and 93.6% in Kithungo/Kitundu, indicated that constraints in rearing indigenous chicken has negatively affected their productivity unlike 2.8% in Kikumini/Muvau and 4% in Kithungo/Kitundu who indicated that constraints in chicken rearing "Has not" negatively affected their productivity (Figure 4.10).

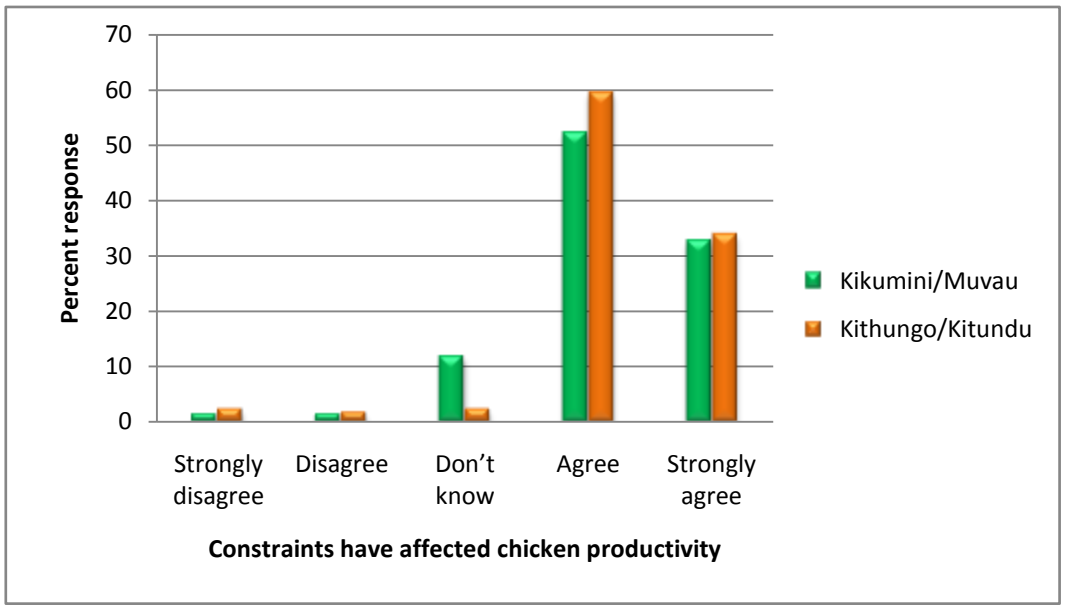


Figure 4.10: Effects of indigenous chicken rearing constraints on productivity

4.2 Biosecurity Measures

4.2.1 Type of chicken housing structure

The study established that 87.1% of the respondents in Kikumini/Muvau and 97.2% in Kithungo/Kitundu housed their chicken (Table 4.16). The birds were housed in semi-permanent houses (temporary) and permanent houses, with semi-permanent houses being the most used by farmers in both wards. In some other cases the respondents who lacked chicken houses opted to keep their birds in their kitchens and granaries.

Table 4.16: Type of Chicken housing structures

Chicken Housing structures	Kikumini/Muvau		Kithungo/Kitundu	
	Frequency	**percent**	**Frequency**	**Percent**
Semi-permanent(temporary)	39	55.7	39	53.4
Permanent	11	15.7	19	26
Kitchen	8	11.4	6	8.2
No housing	9	12.9	2	2.8
Granary	3	4.3	7	9.6
Total	**70**	**100.0**	**73**	**100.0**

Plate 4.1 shows a sample of chicken houses found in some homesteads during the survey. Most chicken houses were poorly constructed with little ventilation, some others had un-plastered wall predisposing chickens to infestation by parasites. A few others were not strong enough exposing chickens to attack by predators like mongoose and honey burgers. The units were smaller in comparison to the moderately higher flock sizes found in some homestead.

When the respondents were quizzed on the requirements of a standard poultry houses, majority (49.2%) in both study wards were aware that it should be constructed to ensure sufficient ventilation, followed by 41.4% who indicated it should have enough light (Table 4.17). Other respondents indicated that, a good poultry house should be easy to clean, able to control wild birds, rodents and predators.

These types of houses encourage invasion by rodents, parasites like fleas, louse and mites. Some lack enough aeration and entry of light creating dampness inside the house and subsequently build up of pathogens. These are some of the biosecurity measures farmers ought to consider.

Plate 4.1: Some samples of poorly constructed chicken houses found in the study area during the survey

Table 4.17: Requirement for a standard poultry house

Conditions for chicken structures	Responses			
	Kikumini/Muvau		Kithungo/Kitundu	
	Freq.	**Per cent**	**Freq.**	**Per cent**
Adequate air circulation	60	26.9	54	22.3
Cleanliness	49	22.0	47	19.4
Enough light	45	20.2	51	21.1
Control of rodents	31	13.9	38	15.7
Control of wild birds	20	8.9	27	11.2
Control of Predators	18	8.1	25	10.3
Total	**223**	**100.0**	**242**	**100.0**

Plate 4.2 shows some of the well ventilated and well lighted chicken houses found during the survey.

Majority of the respondents (85%) had no fence around the chicken houses. Of those who had fenced, 13% did these partially (Semi-fenced) and 2% had a total perimeter fence around their homestead and their poultry units were also fenced (Figure 4.11).

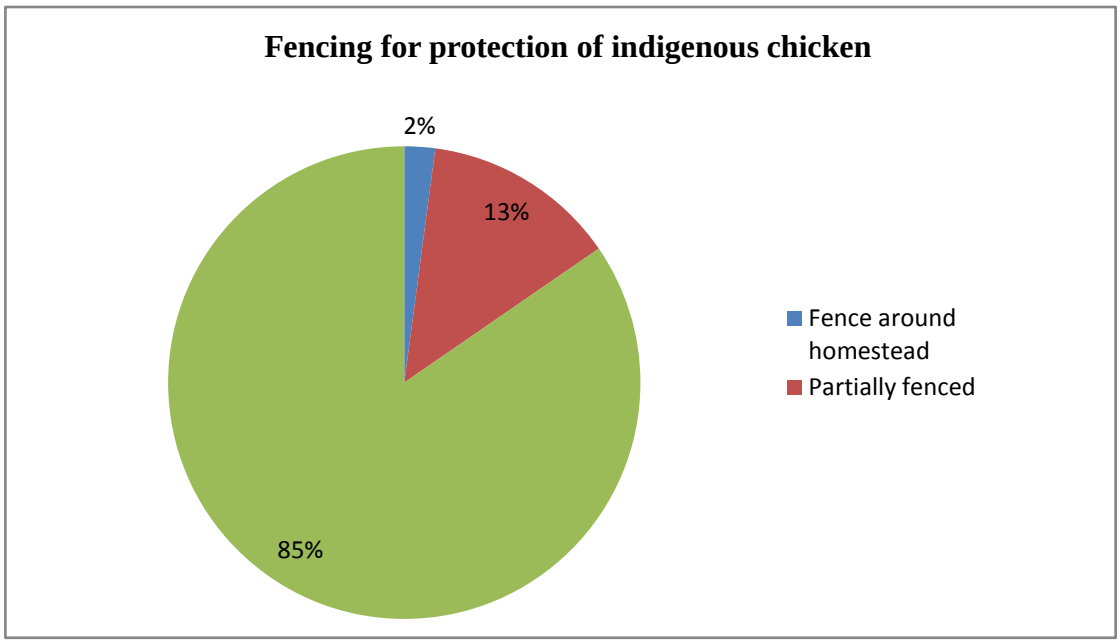


Figure 4.11: Fencing protection for indigenous chicken

Plate 4.2: Samples of some of the well ventilated chicken houses in the study sites

Figure 4.11: Fencing protection for indigenous chicken

Plate 4.3 shows a chicken house with a fence around it where the birds can safely scavenge.

The study found that 59.4% and 72% of the respondents in Kikumini/Muvau and Kithungo/Kitundu respectively had awareness on the importance of using disinfectants and insecticides in their chicken housing units (Table 4.18). A variety of both commercial insecticides and disinfectants were used with Servin® Dudu dust (a carbamate) being the most preferred. Other commercial products/chemicals used included Kerol (a mixture of tar, acids, coal and crude cresol) and Doom® dudu dust, (a synthetic pyrethroid Resmethrin). Other respondents used traditional disinfectants like wood ash.

Table 4.18: Disinfectants used in chicken housing

	Response	**Kikumini/Muvau**		**Kithungo/Kitundu**	
		Freq.	**%**	**Freq.**	**%**
Awareness	Yes	38	59.4	54	72
	No	26	40.6	21	28
	Total	**64**	**100.0**	**75**	**100.0**
Types of Disinfectant	Servin dudu dust	30	83.3	44	84.6
	Kerol	3	8.3	5	9.6
	Doom dust	2	5.6	2	3.8
	Wood ash	1	2.8	1	2
	Total	**36**	**100.0**	**52**	**100.0**
Reason for not using disinfectants	Ignorance	6	27.3	8	8
	High cost of disinfectant	9	40.9	14	56
	No parasites	7	31.8	2	32
	Low economic value for IC	0	0	1	4
	Total	**22**	**100.0**	**25**	**100.0**

4.2.2 Safety of feeds and frequency of cleaning feeding and drinking equipment

The safety measures the respondents used included checking the expiry dates on the label in the packaged feeds and purchasing feeds from reputable companies (Table 4.19). A few other respondents (21.4%) just believed that they fed their birds on clean materials, since kitchen left overs were used by 16%. Still a few (3.6%) in Kikumini/Muvau and 7.8% in Kithungo/Kitundu formulated their chicken feed rations on-farm as a way of ensuring cleanliness.

About two-thirds (58.7%) and half (50%) of the respondents cleaned their chicken feeders and drinkers daily in Kikumini/Muvau and Kithungo/Kitundu, respectively. Similarly 20.6% in Kikumini/Muvau and 26.3% in Kithungo/Kitundu cleaned every two days. A few others (3.2%) in Kikumini/Muvau and 1.3% in Kithungo/Kitundu cleaned weekly. Yet 3.2% in Kikumini/Muvau cleaned chicken feeders and drinkers every two weeks. About 4.8% do not clean the equipment at all and notably 9.5% keep their birds fully on free range with no extra feeding.

Table 4.19: Safety of chicken feeding materials

Variable	Strategy	Kikumini/Muvau		Kithungo/Kitundu	
		Freq.	%	Freq.	%
Methods of ensuring feed safety	Check for the expiry date of feeds	16	28.6	19	29.7
	Buying feeds from reputable companies	14	25	9	14
	Believing feeding materials are clean	12	21.4	14	21.9
	Feeding with clean feeds and fresh leftovers	9	16	11	17.2
	Store my feeds properly	3	5.4	6	9.4
	Formulate feeds	2	3.6	5	7.8
	Total	**56**	**100.0**	**64**	**100.0**
Frequency of cleaning feeders and drinkers	Daily	37	58.7	40	50
	Every two days	13	20.6	21	26.3
	No response (Fully free range)	6	9.5	16	20
	No cleaning	3	4.8	2	2.5
	Weekly	2	3.2	1	1.3
	Every two weeks	2	3.2	0	0
	Total	**63**	**100.0**	**80**	**100.0**

4.2.3 Sources of breeding stock

Farmers in the two wards sourced breeding chicken from a variety of sources. The main source of breeding stock was selection from within own flock (Table 4.20). Other important sources included sourcing from neighbours, local small scale hatcheries (small capacity incubator owners within the county) and buying breeding birds from the local markets. Less important sources included county government support and purchasing from reputable biosecure hatcheries such as Kenchic, Kuku chick, Daluc farm Muguku farm and Ideal farm.

Table 4.20: Sources of breeding Stock

Source of breeding stock	**Kikumini/Muvau**		**Kithungo/Kitundu**	
	N	**Percent**	**N**	**Percent**
Own flock	31	51.7	38	48.7
Neighbours	12	20	15	19.2
Local mini hatcheries	9	15	12	15.4
Renowned biosecure hatcheries	5	8.3	9	11.5
Local market	3	5	1	1.4
County government	0	0	3	3.8
Total	**60**	**100.0**	**78**	**100.0**

4.2.4: Mode of transporting breeding stock from the source to the farm

Birds destined for market or for breeding were transported using a number of means which included public service vehicles (PSV), bicycles, motorcycles and by hands (Table 4.21). Public service vehicles were the most used means of transport and bicycle were the least used.

Table 4.21: Mode of transporting breeding stock from source to the farm

Mode of transport	Kikumini/Muvau		Kithungo/Kitundu	
	N	**Percent**	**N**	**Percent**
Public vehicles	26	40	32	55.2
Bicycles	6	9.3	7	12.1
Motorcycles	19	29.2	12	20.7
Man (by hand)	14	21.5	7	12.0
Total	**65**	**100.0**	**58**	**100.0**

The birds are packed and transported in commercial cages, held by the hands and yet others are packaged and transported in locally made wooden cages.

As a precaution to avoid introducing diseases and parasites into their already existing chicken flock, farmers in both wards reported doing due diligence on any bird bought for breeding. This included thorough physical examination for disease signs, presence of parasites, vaccination, buying from known sources and selection from within the flock for breeding (Table 4.22). The most preferred practice for excluding chances of introducing diseases and parasites into the flocks was thorough physical check up of birds before purchasing, with those with problems avoided.

Plate 4.4 below shows some of the ways used to transport breeding stock from off-farm sources to the farm. Some are carried by well designed cages, others by hand and yet others by locally made wooden cages.

Table 4.22: Methods used to minimize diseases and parasites in breeding stock

Practices to minimize diseases/parasites	Kikumini/Muvau		Kithungo/Kitundu	
	Freq.	**Percent**	**Freq.**	**Per cent**
Physical observation	29	39.7	30	42.9
No action	18	24.7	10	14.2
Vaccination	7	9.6	14	20
Buy from known sources	9	12.3	6	8.6
Strict use of own birds for breeding	4	5.5	6	8.6
Keeping the house clean	2	2.7	3	4.3
Give herbs (E.g. Aloe, chilli etc)	4	5.5	1	1.4
Total	**73**	**100.0**	**70**	**100.0**

4.2.5 Animals that chicken flocks interacted with on the farm

In both wards indigenous chickens interacted with wild birds, other livestock in the farm, chicken from neighbouring farms and birds on transit to the market (Figure 4.12).The chickens in both wards interacted mainly with wild birds, followed by other livestock in the farm as well as chickens from their neighbours homesteads. A few (5%) reported their chickens interacting with birds on transit to and from the market.

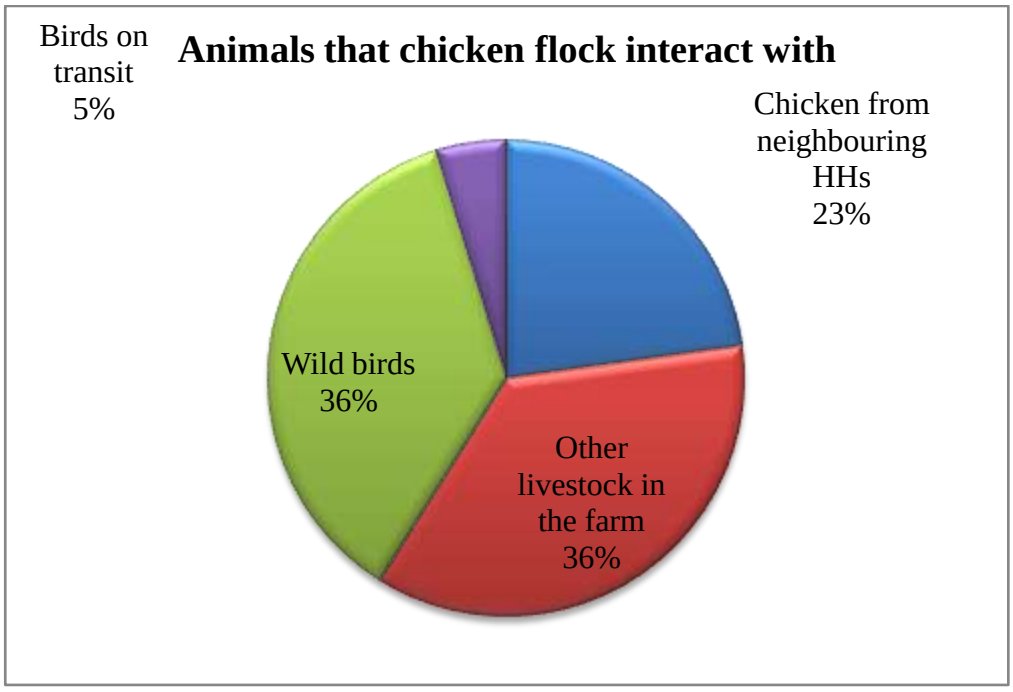


Figure 4.12 Animals that indigenous chicken interact with

4.2.6 Biosecurity measures in the farms

The computed composite scores were 54.6% who agree that biosecurity is inadequate while 40.5% indicate that it is adequate in Kikumini/Muvau. In Kithungo/Kitundu 58.4% and 39% agree and disagree for "Inadequate" and "Adequate" respectively which is a confirmation that Biosecurity measures in the indigenous chicken farms were not adequate (Figure 4.13). The enumerators described in details to farmer what biosecurity is and what biosecurity measures are. So farmers were responding from an informed angle.

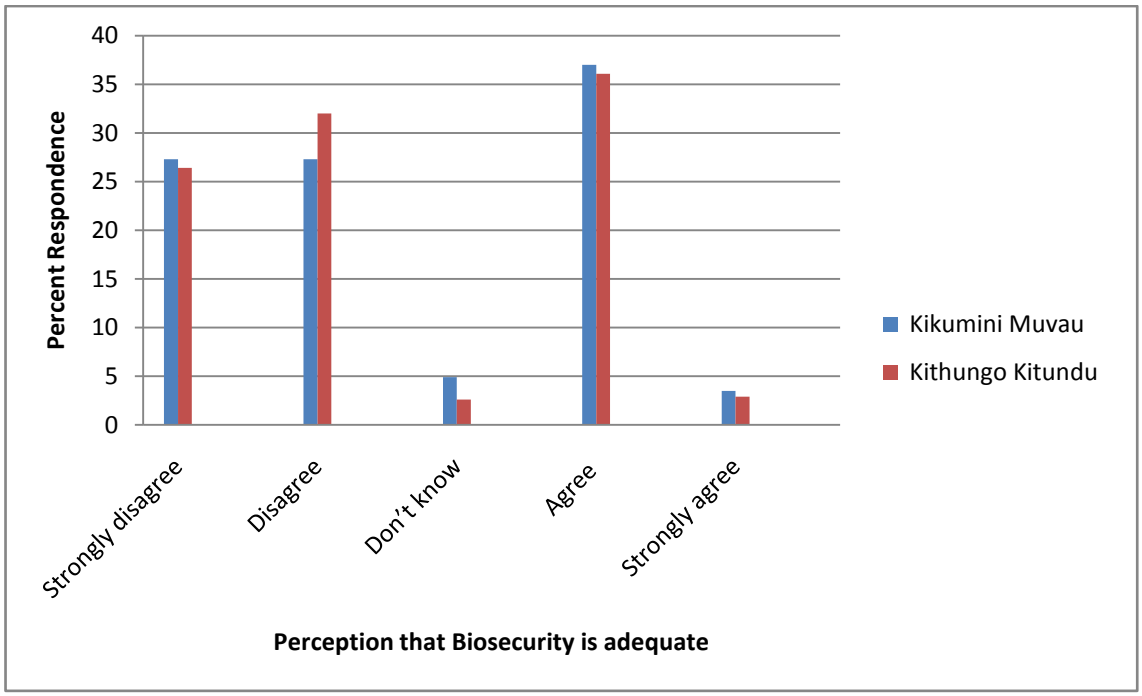


Figure 4.13: Perception of adequacy of the biosecurity measures in the farms

4.3 Socio-Economic and Ecological factors that hinder the adoption of Biosecurity measures

The third objective sought to assess the socio-economic and ecological factors that hinder the adoption of biosecurity measures in the study area. The results from the study survey are presented in the sections below.

4.3.1 Ownership of Indigenous Chicken

In both study wards, respondents indicated that, at household level, although indigenous chickens were mainly owned by women (wives) for subsistence (small) flock size, men (husbands) were also important players (especially when the flock attains commercialization levels with high revenue generation (Figure 4.14). Joint family ownership was at 21% while some chicken were owned by children.

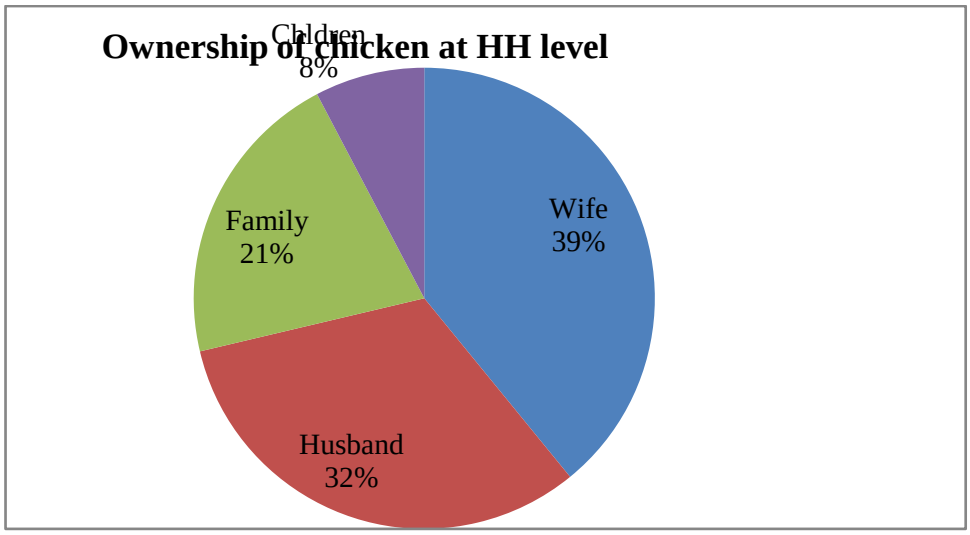


Figure 4.14: Ownership of Indigenous Chicken

Ownership of the land occupied by the households was mostly by men (husband) closely followed by communal land ownership and joint ownership by both husband and wife (Figure 4.15). Some land was owned by family and some by women.

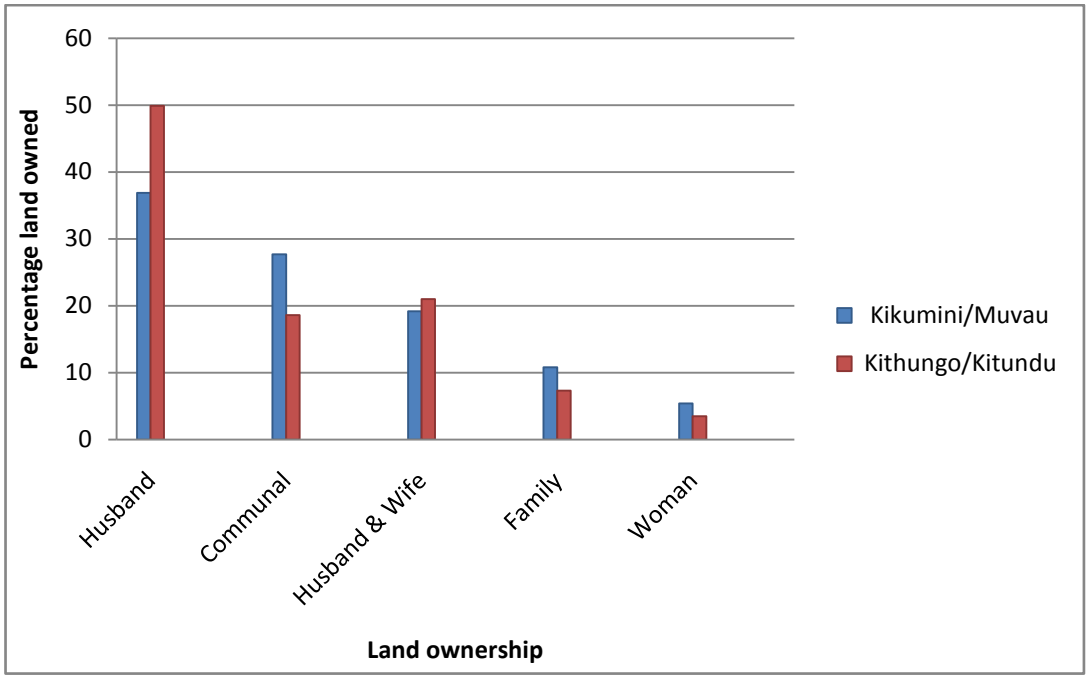


Figure 4.15: Ownership of land where Indigenous chicken are kept

4.3.2 Labour provision for chicken management

The management of chickens was the responsibility of members of the households. In the two wards, there were no reports of employment of people to solely manage chicken. However, the number of household members attending the chickens in the units varied from one person to three people. In Kikumini/Muvau, 57.3% of the respondents indicated that only one member of the household attended the chicken unit, 37.8% and 4.9% reported that two and three members of their households attended to the chickens. In Kithungo/Kitundu 68% reported that one member worked in the chicken unit followed by 28.4% who reported two members while 3.6% indicated that three members of the household attended the chicken units (Figure 4.16).

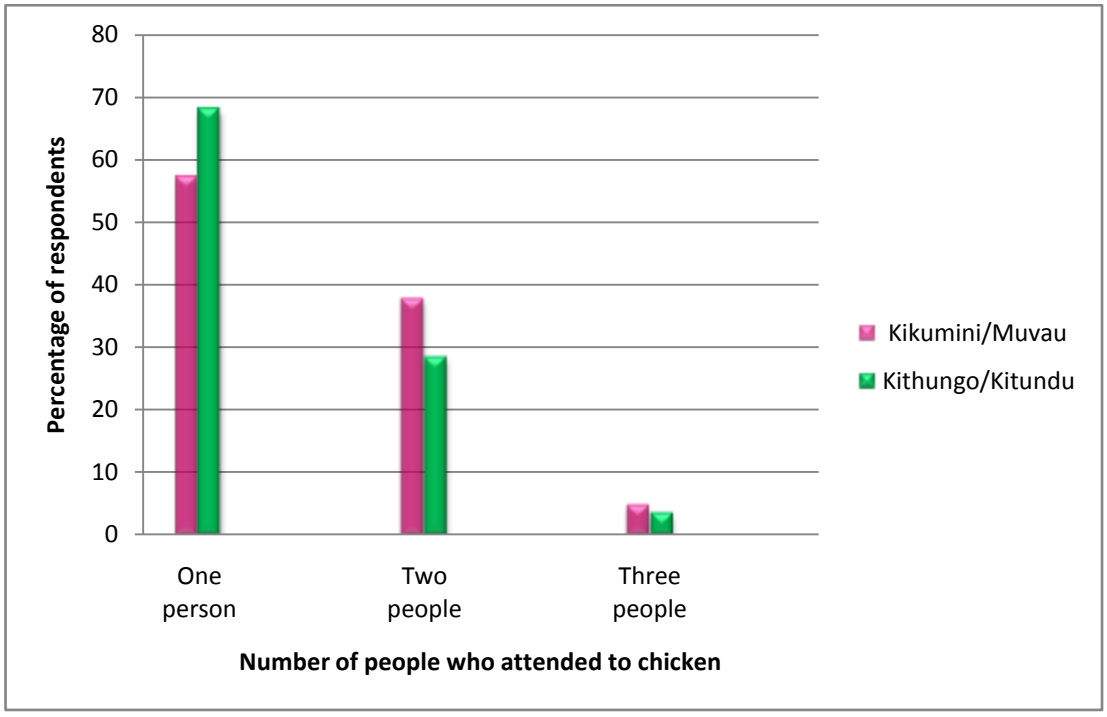


Figure 4.16: Number of Household Members who attend to Chicken

4.3.3 Diseases and pests control strategies used by the farmers

The respondents in both study wards reported using a number of approaches to manage diseases and parasites in their indigenous chicken flocks (Table 4.23). Regular vaccination and maintenance of cleanliness in the chicken house were the two main disease prevention strategies used. Procuring breeding stock from disease free sources, keeping birds of different ages separately, regular disinfection of chicken houses and isolating infected birds from the rest of the flock were other approaches used in controlling diseases and parasites.

Table 4.23: Diseases and pests control strategies used by the farmers

Diseases control strategies	**Kikumini/Muvau**		**Kithungo/Kitundu**	
	N	**Percent**	**N**	**Percent**
Maintaining cleanliness in the chicken house	30	20.3	44	22.1
Ensuring regular vaccination	38	25.7	32	16.1
Isolating all infected birds	12	8.1	39	19.6
Procuring breeding stock from diseases free sources	29	19.6	34	17.1
Regular use of disinfectant	19	12.8	28	14.1
Keeping different ages and types of birds separately	20	13.5	22	11
Total	**148**	**100.0**	**199**	**100.0**

Decision on whether to treat diseased birds or not were made at household level by husbands, wives, jointly, farm attendants and in some cases professionals (Figure 4.17).

On disease control and affordability, about 75% of respondents in Kikumini/Muvau and 76% in Kithungo/Kitundu reported controlling chicken diseases and parasites affordably (Table 4.25). A number of chicken disease control strategies were used by farmers in

both wards. Regular vaccinations, treatment with assortment of antibiotics and culling were the main disease and pests control strategies. Dusting birds and chicken housing units (to control Ecto-parasites), disinfection and isolating sick birds were also used.

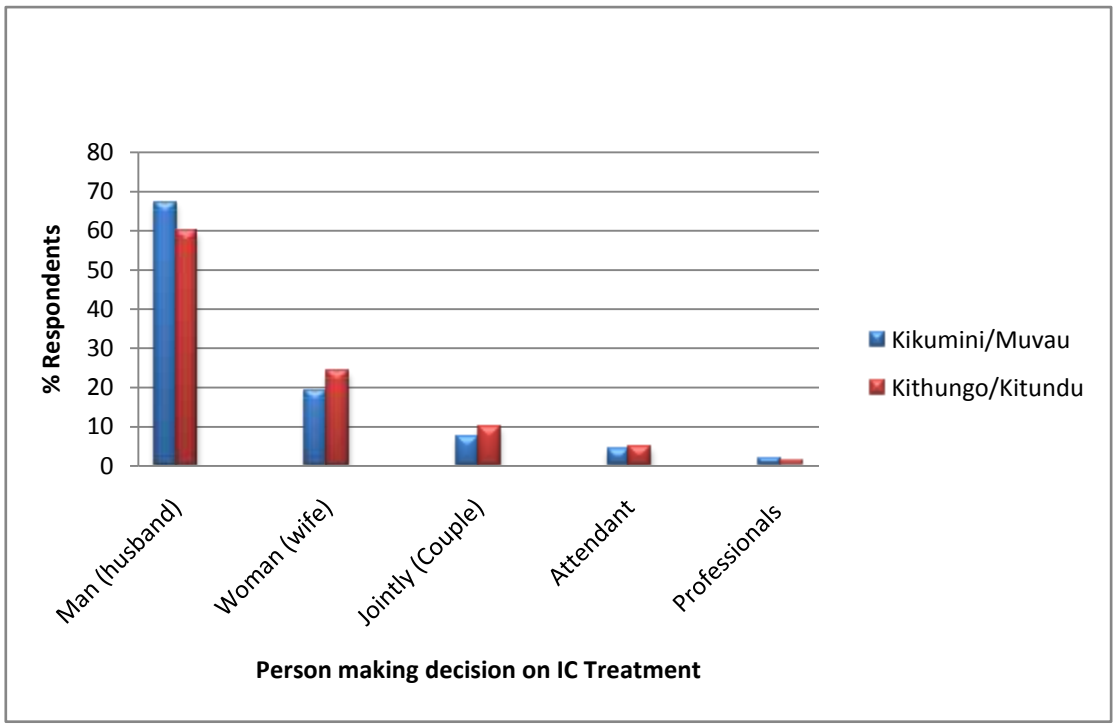


Figure 4.17: Decision for treating chicken

Table 4.24: Chi-Square Statistics on diseases and parasites control strategies used by the farmers

Diseases and pests control strategies	Kikumini/Muvau			Kithungo/Kitundu			p-value	Row Totals
	F (Observed variables)	Expected cell totals	chi-square statistic for each cell.	F(Observed variables)	Expected cell totals	chi-square statistic for each cell.		
Maintaining cleanliness in the chicken house	30	31.56	0.08	44	42.44	0.06	0.01650	74
Ensuring regular vaccination	38	29.86	2.22	32	40.14	1.65	0.01800	70
Isolating all infected birds	12	21.75	4.37	39	29.25	3.25	0.01910	51
Procuring breeding stock from diseases free sources	29	26.87	0.17	34	36.13	0.13	0.01780	63
Regular use of disinfectant	39	37.96	0.03	50	51.04	0.02	0.01610	89
Column Totals	148			199				347 (Grand Total)
The chi-square statistic is 11.9765. The p-value is 0.017527. The result is significant at $p < 0.05$								

Chi-square statistics at $p < 0.05$ indicated that, the Diseases and pests control strategies used by the farmers are significant factors in influencing adoption levels of biosecurity measures (Table 4.24).

Table 4.25: Methods used to control diseases and affordability of cost

	Response levels	**Kikumini/Muvau**		**Kithungo/Kitundu**	
		N	**Percent**	**N**	**Percent**
Is cost of Controlling diseases affordable?	Yes	47	75	61	76
	No	16	25	19	24
	Total	**63**	**100.0**	**80**	**100.0**
Methods applied	Regular vaccination	26	37.1	31	43.1
	Use of antibiotics in drinking water/feeds	17	24.3	24	33.3
	Cull birds immediately	9	12.9	7	9.7
	Dust those infected by parasites	8	11.4	5	6.9
	Disinfecting	6	8.6	4	5.6
	Isolate all sick birds from the flock	4	5.7	1	1.4
	Total	**70**	**100.0**	**72**	**100.0**
Reasons for not controlling diseases	Inadequate of resources	24	42.1	38	46.3
	I C are resistant to infections	17	29.8	26	31.7
	Lack of knowledge to control diseases	14	24.6	18	22
	Not a priority	2	3.5	0	0
	Total	**57**	**100.0**	**82**	**100.0**

Failure to control diseases and parasites was attributed to inadequate resources, suspicions of failed treatments due to resistant organisms to commonly used drugs and chemicals, inadequate knowledge and the fact that chicken were not taken as priority farm enterprise. Disease control was mainly done individually (69.2%), with only 30.8% of the respondents partnering with other farmers (in farmer groups).

4.3.4 Channels used in marketing of chickens

Middlemen (brokers) were the largest marketing channel of chicken in the two wards as they visited farmers and bought chickens directly from the villages (Figure 4.18). This was followed closely by farmers themselves taking their birds to the market to sell. In both wards, a few (3.8%) from Kikumini/Muvau and 1.4% from Kithungo/Kitundu reported that they did not sell their birds at all.

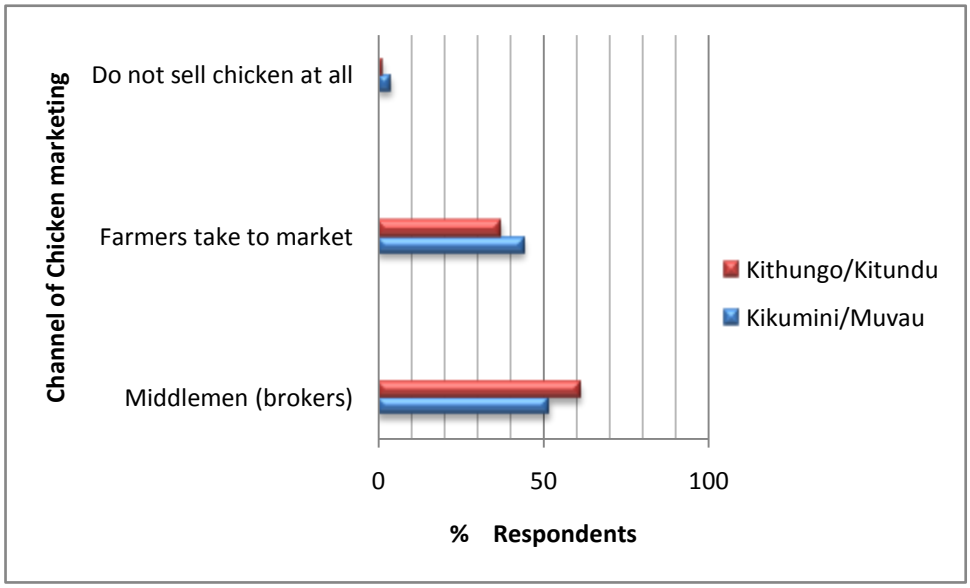


Figure 4.18: Chicken marketing channels in both wards

4.3.5 Effect of environment on chicken productivity

In both study wards, environmental conditions were reported to negatively affect chicken productivity. In particular, the low temperatures experienced in the month of June to July have a huge impact as this is associated with diseases outbreaks especially Newcastle disease (ND) as shown in Table 4.25. It was also reported that bushes surrounding homesteads served as hideouts for predators. Other environmental effects were inappropriate fencing, farming activities in the neighbouring households, family land ownership and small land sizes.

Table 4.26: Impact of environment on chicken productivity

	Kikumini/Muvau		Kithungo/Kitundu	
Environmental impact on chickens	**N**	**Percent**	**N**	**Percent**
Cold (June – July) outbreak of disease	24	42.9	31	39.7
Bushes (hiding place for chicken predators)	11	19.6	18	23.1
Interaction of chicken from neighbours	9	16.1	11	14.1
Land sub-division and diminishing land sizes	7	12.5	12	15.4
Joint family land ownership discourages fencing and proper chicken protection	5	8.9	6	7.7
Total	**56**	**100.0**	**78**	**100.0**

4.3.6 Future Trends in Indigenous Chicken farming

In both study wards, respondents were positive about the future outlook of indigenous chicken farming in their areas. They gave an assortment of opinions, with majority of those interviewed expressing their willingness to expand their existing chicken flocks and upgrade the same from subsistence scales to commercial levels (Figure 4.19). Still some others wished to enhance egg productivity and perhaps with an intention of increasing

their income base and establish own hatchery facilities. A few projected to put in place structures for promoting disease free chickens.

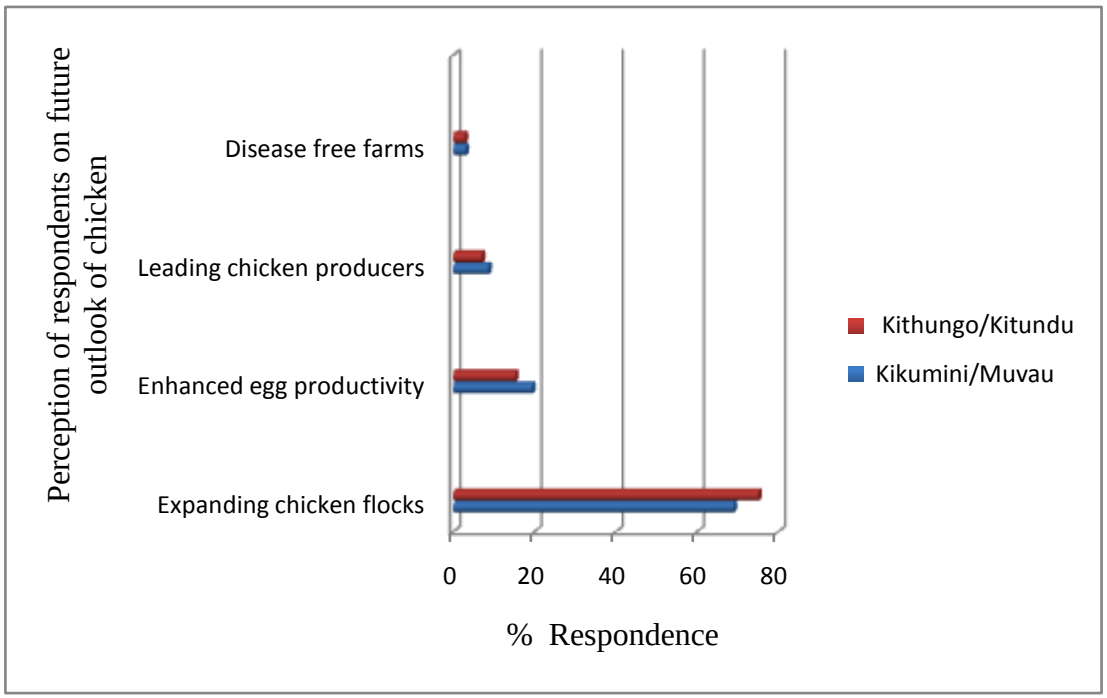


Figure 4.19: Future Trends in Indigenous Chicken production

4.4 Main constraints in chicken production in Kikumini/Muvau ward

During FGD in Kikumini/Muvau (Plate 4.5) the participants recorded numerous constraints that affect chicken productivity. These included diseases and parasites, theft of chicken, predators (both aerial and terrestrial), poor housing, high cost of chicken feeds, low skills in chicken management, high costs of chicken drugs and chemicals, inadequate extension services, unavailability of improved chicken breeding stock and costly chicken equipment. Upon prioritization diseases and parasites, inadequate extension services and high cost of chicken feeds were the greatest bottle necks to chicken productivity in this ward (Table 4.27). Others were poor housing, low chicken rearing skill, predators and chicken theft.

Table 4.27: Pair wise matrix for ranking main constraints of chicken production in Kikumini/Muvau ward

	DP	**IE**	**CF**	**TF**	**PH**	**LS**	**PT**	**Score**	**Rank**
DP		DP	DP	DP	DP	DP	DP	**6**	**1**
IE			IE	IE	IE	IE	IE	**5**	**2**
CF				CF	CF	CF	CF	**4**	**3**
TF					PH	LS	PT	**0**	**7**
PH						LS	PH	**3**	**4**
LS							PH	**2**	**5**
PT								**1**	**6**

Key: DP- Diseases & parasites, IE-Inadequate extension services, CF-High cost of feeds, TF-Theft, PH- Poor housing, LS-Low skills, PT- Predators.

The participants in Kithungo/Kitundu FGD (Plate 4.6) also faced challenges such as terrestrial predators, poor housing structures, diseases, parasites, chicken theft, inadequate knowledge and skills in rearing of chicken and shortage of feeds, high costs of chicken equipment, costly drugs and disinfectants and inadequate service providers especially vaccinators. On prioritizing, costly chicken feeds, diseases and parasites, inadequate skills and knowledge of chicken husbandry were the main drawbacks (Table 4.28). Other constraints were inadequate service providers, poor housing and terrestrial predators.

Table 4.28: Pair wise matrix for ranking main constraints in chicken production in Kithungo/Kitundu ward

	DP	PH	TP	IK	CF	SP	Score	Rank
DP		DP	DP	DP	CF	DP	**4**	**2**
PH			PH	IK	CF	SP	**1**	**5**
TP				IK	CF	SP	**0**	**6**
IK					CF	IK	**3**	**3**
CF						CF	**5**	**1**
SP							**2**	**4**

Key; DP- Diseases & parasites, PH-poor housing, TP-Terrestrial predators, IK-inadequate knowledge, CF-Cost of feeds, SP- inadequate service providers

Plate 4.5: Participants during Focused Group Discussion in Kikumini /Muvau ward

Plate 4.6: Participants during FGD in Kithungo/Kitundu ward

4.5. Biosecurity issues in chicken production

From the discussions it was noted that vaccination, fencing (although limited) and confinement of chicks for up to two weeks, disinfection of housing units, isolation of sick birds, cleaning of chicken houses and utensils were undertaken. However other measures on biosecurity such as traffic control, use of dedicated clothing and shoes, warning signs and caution at the fence and at the gate ought to be practiced. The participants confirmed continued use of herbs such as Aloe species, chillies, star grass leaves, neem tree leaves and croton barks to control parasites and diseases and disinfection of chicken houses to a limited extend.

4.6 Marketing of chicken and prices at farm gate and at the market

In both study wards, chickens besides being kept for domestic consumption were also kept for sell to raise cash for domestic expenditures. Marketing was done locally through local buyers (middle traders) and in local market centres. Some birds were sold to the neighbours as breeding stock. About 20-35 birds and 40-60 eggs were sold per household per year. Chickens were mostly sold in April, December (festive seasons), during crop germination and during dry spells when there was critical shortage of food for human as well as shortage of feeds for the chicken.

Although there were price variation for chicken in both wards, Kithungo/ Kitundu had higher farm gate and market place prices compared to Kikumini/Muvau (Table 4.29).

Two weeks old chicks were sold in Kithungo/Kitundu ward while in Kikumini/Muvau day old and two weeks old were not sold.

Table 4.29: Prices of eggs and chicken at different ages

Poultry type/product	Average unit price at farm gate (KES)		Average unit price at the Market place (KES)	
	K/M	K/K	K/M	K/K
Eggs	10	10	15	20
Day old chicks	Not sold	Not sold	Not sold	Not sold
Two weeks old chicks	Not sold	150	Not sold	200
One month old	200	250	250	300
Growers	300	400	350	450
Pullets	400	550	500	600
Cockerels	500	700	600	800
Hens	600	700	700	800
Mature Cocks	800	900	1000	1200

Key: K/M-Kikumini/Muvau, K/K-Kithungo/Kitundu

CHAPTER FIVE

5.0 DISCUSSION

5.1 Introduction

In both study wards greater number of respondents were females (58%). This can be explained by the fact that most of the adult males have migrated to urban centres in search of jobs (salaried employment) to improve their livelihood. They leave their wives at home to take care of the farms. Only the aged males (over 55 years) were found at home and interviewed. This class of people cannot undertake heavy farm duties, affecting farm productivity. Small land size and heavy occupation of crops in the farms during the better part of the year explains one of the reasons why large flock size of indigenous chicken on free range production system cannot be kept in Kithungo/Kitundu ward.

5.2 Constraints that affects the productivity of indigenous chicken

Indigenous chicken farmers in the study wards are faced with wide range of challenges. These challenges included diseases and parasites, high cost of feeds and inadequate extension services as the major ones. Since the freeze of mass employment by government over two decades, farmers receive limited extension services from the few workers available per ward. However non-governmental staffs do supplement government services. Other challenges faced were inadequate skills in chicken management, chicken theft, and conflict with neighbours especially where chicken are kept on free range system of production. Predator attack was indicated as a constraint of lesser impact. This echo the findings of Ondwasy *et al*., (2006), who reported that Indigenous chicken have not attained their full production potential due to exposure to risks that militate against their survival and productivity. New castle disease still remain a menace in both wards (77.9%) followed by Gumboro (Infectious Bursal disease), Fowl pox, Coccidiosis, and respiratory diseases. These diseases have remained a threat to the chicken farmers because the farmers have not embraced vaccination as the recommended approach to control diseases before outbreaks. Poor chicken housing with less frequency

of cleaning and limited disinfection were also mentioned as the reasons why Coccidiosis is experienced in the two wards. These findings are in agreement with findings of King'ori *et al*., (2010) in their study on indigenous chicken production in Kenya. Newcastle disease is one of the most significant diseases for poultry producers around the world (Okwor and Eze, 2011). The inadequate use of modern methods of managing indigenous chicken diseases was found to be another constraint facing chicken production in the study area. High use of herbs by 43.3% of chicken farmers in Kikumini/Muvau and 28.4% in Kithungo/Kitundu is indicative of how conventional chicken drugs have not been embraced in the both study wards either due to their costs, inaccessibility or merely lack of awareness of their availability or/and perceived ineffectiveness due to previous misuse of the antibiotic. Most farmers in Kithungo/Kitundu buy drugs and vaccinate their birds as indicated by 36.5% and 20.2% respectively indicated to practice these. On the contrary in Kikumini/ Muvau vaccination is very low (18%). This is a low percentage bearing in mind that the area is normally affected by four killer diseases, namely New castle disease, Fowl Pox, Fowl typhoid and Gumboro which annually combined claim over 70% of chicken in Makueni County. Low usage of veterinary officers in the study area (13.3% in Kikumini/Muvau and 11.5% in Kithungo/Kitundu) is attributed to the low number of government extension staff including veterinary officers in the county where extension staff: farmer ratio is 1:1800 (CDA, 2013).

Cleaning of chicken houses though practised by large number of the farmers (86.8% in Kikumini/Muvau ward and 74.9% in Kithungo/Kitundu), on its own is not really effective strategy in controlling of parasites. Use of vermin dust is better approach but practised by few farmers. The above two measures of controlling parasites is laudable but use of wood ash, splashing of water and detergents as indicated by over 33% of respondents. Related results were reported by, Khandait, *et al., (*2011) in India where only 27.44% of the interviewed respondents adopted health care practices and in Tanzania, Mfaume, (2008) reported that 69% of the farmers occasionally clean the chicken night shelter.

The findings reveal that low numbers (29.6%) of the farmers in Kikumini/Muvau and in Kithungo/Kitundu (47.3%) were trained on chicken management. Gender-wise, the training benefited 41.5% female and 26.2% male farmers in Kikumini/Muvau and 49.4% female and 27.7% male farmers in Kithungo/Kitundu. The training carried out in Kithungo/Kitundu followed distribution of chicken breeding stock distributed by the Government of Makueni County in the ward in 2015. Much of the training done in Kikumini/Muvau was carried out in 2013 when Climate Change, Agriculture and Food Security (CCAFS) project was capacity building chicken farmers in preparation for breeding stock of chicken distributed to farmers in 2015. More male farmers than female farmers participated in the trainings. However, females (women) are the actual care takers of indigenous chicken. The low number of farmers and the wrong gender trained confirms the reason why adoption of modern methods of diseases and parasites management is low. These findings are supported by Okitoi and Mukisira (2001) who reported that technologies for improved management do not reach the small scale farmers who are mainly women and children. Other reports by Njue *et al.,* (2006) in their study revealed that majority of smallholder farmers with smaller flock size hardly realizes improved productivity, due to the manner in which they selectively adopt or refuse to adopt disseminated management interventions package and, production practices. The disseminated management interventions package to improve productivity of IC includes housing, feed supplementation, vaccination, brooding, and improved chick rearing system (Njue *et al*., 2006).

The study established that 74.1% of farmers use free range method of indigenous chicken production. This method coupled with poor housing and mixing with neighbours chicken pose great danger of spread of diseases and parasites across farms. The lack of appropriate shelter to house birds exposes them to vagaries of the weather which tends to affect productivity. These observations are supported by the findings by Onuekwusi (2001) in a survey of commercial poultry production in Nigeria which showed that more than half of the surveyed poultry farms did not provide adequate housing or shelter for their chicken. Majority (90.2%) of the farmers supplement their chicken. However the

supplement feeds given are mostly from whole grains produced at their farms, leftovers, green vegetables which may not provide balanced diet. The lack of balance diet given indigenous chicken does not catalyse their growth or faster weight gain but contributes to low production of meat and eggs. This state of affair is supported by Ali (2012) who argues that in most cases farmers don't offer balanced or standard feeds instead they provide supplements of grains and food residues. Best practices recommend that commercial feeds with proper formulation (balanced diet) should be used to supplement free range indigenous chicken production. Use of low quality feeds materials to supplement indigenous chicken is attributed to high cost of commercial feeds. This fact is supported by King'ori *et al*., (2010) who found out that the prices of feeds have been constantly increasing. Due to recent global changes in the price structure of the cereal grains and other feed stuffs, the poultry industry at present is handicapped on account of high feed cost which have gone over to more than 60% of the total cost of production (King'ori *et al*., 2010). Obtaining quality poultry feed also presents a challenge to poultry famers. Poultry feed by its quality and price is the major factor in determining the cost of poultry products.

Chicken production extension services are provided by the government, private sector, NGOs, FBOs and CBOs and a high number of farmers reported accessing information through different channels. Most (48.0%) of the farmers got their services from mass media (radio and TV) followed by field days or shows at 30.7%. The study also established that 53.8% were satisfied with extension services provided. However, the extension services are faced by a number of challenges such as mismatch of the extension messages delivered, low value attached to indigenous chicken and low literacy levels among the farmers. The above revelations concur with the findings by Ochieng *et al.*, 2013, who established that poor packaging of extension messages have not encouraged farmers to improve indigenous chicken production in Kenya.

Majority (85.3%) of the farmers agreed that constraints facing production of indigenous chicken have negatively affected productivity in both study wards. The major constraints included diseases, parasites, high cost of feeds, and costly construction materials. Similar studies (Mapiye *et al*., 2008, Fisseha *et al.,* 2010, Magothe *et al.,* 2012, Oosthuyen, 2013, Gwala, 2014 and Butler, 2016) also indicate these as production constraints faced by many chicken farmers. From their study, King'ori *et al*., (2010) also argued that the poultry industry in Kenya has not been doing well due to various challenges like diseases and assortment of other challenges. The outbreak of the deadly Avian Influenza in the Asia and Eastern parts of Europe had negative effects on the poultry industry globally and in the country too (Tham-Agyekum and Appiah, 2010). Other researchers (Adebayo and Adeola, 2005, Mapiye *et al.*, 2008, Bongani and Masuku, 2013, Ndathi *et al.*, 2012 and Kyule *et al.,* 2015) found socio-economic factors as crucial constraints in chicken production in their studies. Ownership of chicken at household level and land ownership are also other socio-cultural challenges facing indigenous chicken farming in the study area. Different studies (FAO, 2004, FAO, 2008, Fisseha *et al.*, 2010 and Ndathi *et al.,* 2012) also found socio-cultural aspect in different communities as constraints that affect indigenous chicken production.

5.3 Biosecurity Measures

Although some biosecurity measures were practiced, they were not adequate to fully protect indigenous chicken. The study established that majority (78.3%) of indigenous chicken houses were not permanent or the birds had no houses at all. The lack of adequate chicken housing exposes the birds to biosecurity challenges like spread of diseases and parasites and predation among many others. The challenge of poor housing for chicken production is a major problem among the small scale indigenous chicken farmers. These findings concur with the study findings on biosecurity assessment in Kenya by Mugambi *et al.,* (2007) and Nyaga (2007a) which found that poor housing contributes to high incidences of disease and parasites among farmers keeping indigenous chicken. The biosecurity of indigenous chicken was found wanting when their fencing

situation was explored. The study found that only 2.1% of the farmers in both study wards had an adequate perimeter fence for protecting their indigenous chicken. These revelations pose a serious risk of ensuring biosecurity of the birds since the birds will not be protected from wild birds, neighbours chicken and predators. The kind of fencing done does not adequately prevent introduction and spread of chicken diseases among the farms. This situation results in far reaching challenges of controlling chicken disease outbreaks. This observation agrees with findings of Nyaga (2007 a) in his study on the strategies of the prevention and control of infectious diseases where he found that lack of confinement of chicken in housing and in secure perimeter fence compounds largely contributed to the potential spread of highly pathogenic Avian Influenza in East Africa.

It emerged from the study that majority (66.2%) of the farmers are aware of the need to disinfect the chicken housing and that 97.7% use appropriate disinfectant with a small proportion (2.3%) using wood ash. The use of appropriate disinfectant is commendable however due to lack of proper chicken housing and poor or lack of perimeter fencing would mean that the birds' biosecurity will not be assured. The farmers interviewed practice various strategies of safety measures to ensure safe feeding of indigenous chicken. These safety measures included ensuring commercial feeds have not expired; buying commercial feeds from reputable companies, ensuring leftovers are clean among others. A large number of farmers (53.8%) clean feeders and drinkers daily. This practise is applaudible because it reduces accumulation and the spread of germs through feeding and drinking containers. The findings that biosecurity measures are being practiced by about 46.2% of the farmers show adequate adoption. Although many commercial hatcheries in Kenya practiced high biosecurity measures, only 1.6% of the farmers procure birds from these hatcheries. Majority (77.2%) restock from their own farms and 62.6% from their neighbours. This implies that biosecurity of breeding stock cannot be assured since majority of the small-scale farms are not bio-secure. Transportation of breeding birds by public vehicles was the most preferred method. These methods are likely to compromise biosecurity of the breeding materials due to possible contamination.

Disease causing agents can be transferred from one flock to another during bird transportation so the mode of transportation is critical in ensuring chick biosecurity. Uncontrolled interactions of chicken, at 59%, with wild birds and chicken from neighbouring households present high chances of spread of disease causing agents and parasites. Overall the study established that farmers in the study wards have not put in place adequate biosecurity measures to protect their indigenous chicken.

5.4 Socio-Economic and Ecological Drivers that Hinder the Adoption of Biosecurity Measures

Indigenous chicken are mostly (39.2%) owned by women followed by 32.2% family (wife and husband) ownership. However, 36.9% of the land is owned by husbands (men) as compared to 5.4% women ownership. These findings show that there is no relationship between land and chicken ownership as fewer women own land and they are the majority chicken owners. Furthermore based on the production system, a times land is not a challenge to chicken farming. These findings are supported by Kryger *et al.,* (2010) who noted that socio-economic status of farmers can vary according to poultry production systems with men associated with large scale intensive production which require much land due to construction of structures, while women deal with free range systems small scale production that need minimal land size.

This study established that majority (57.3%) of the chicken units are managed by at least one member of the family. This can be attributed to the fact that the method of production is free range which is not labour intensive. Most (67.2%) of the decisions on acquiring drugs for treating chicken are made by the women as compared 19.1% by men. The high number of women making decision on acquisition of chicken drugs is simply because majority of the chicken is owned by women who are also available at the farm most of the time. These findings are supported by the study by Nduthu, (2015) on the social-economics influencing indigenous poultry production in Machakos-Kenya which found that 67% of indigenous chicken is owned by women. The same was noted by Halima, (2007) that majority of women in North-West Ethiopia own and are responsible for

chicken rearing in both male and female headed households. In a number of African countries, approximately 80% of the chicken flocks are owned and largely controlled and managed by rural women (Mcainsh *et al*., 2004).

According to the study results, most of the respondents (75.5%) agreed that they can afford to control chicken diseases. However some have challenges of managing chicken diseases due to inadequate resources. It also emerged that majority (69.2%) of the farmers are not in chicken producer groups and so they control the parasites and diseases individually. These revelations imply that the control of chicken diseases is not a collective affair. The study established that majority 51.9% of the farmers market their chicken through middle men while 44.3% take the birds to the market themselves. The findings above shows that middle men control indigenous chicken marketing. Middle men usually offer low prices. This observation concurs with the study findings by Mutombo (2015) who established that middle men are the major buyers of indigenous chicken where they offer low farm gate prices.

This survey further revealed that most of the farmers feel that the environmental impact negatively on chicken production. The cold months of June, July and August result in diseases outbreaks, bushes around the homesteads that hide predators, while diseases from the neighbouring farms affect their chicken production. These findings concur with the study by Sabuni, (2011) who found that climate variability can alter poultry's relationship with parasites and vectors thrive better in different weathers. The study established that chicken farmers would like to improve their indigenous chicken production. For instance 80% would like to see their flock expand; others would like to be major egg and chicken suppliers while other would like to manage disease free farms. Indigenous chicken farming can be profitable if proper management practices are put in place concludes Mutombo, (2015).

CHAPTER SIX

6.0 Conclusions and recommendations

6.1 Conclusions

This study concludes that;

1. Challenges faced in chicken production in the two study sites were:-Diseases, parasites, high cost of feeds and feed ingredients, as the major, with New castle disease, Gumboro (Infectious Bursal disease) and Fowl Pox are a menace.

2. Inadequate knowledge about biosecurity undermines farmers' ability to effectively apply appropriate biosecurity principles at the farm.

3. Means and channels of disseminating poultry extension messages and occupation of indigenous chicken producers were also found to have significant influence on adoption of biosecurity measures.

4. Type and safety of feed supplemented to chicken has a significant influence on adoption of biosecurity measures.

5. There is no policy on biosecurity in Livestock enterprises in the study area.

6.2 Recommendations

1. The study recommends increased well packaged trainings on diseases and general chicken husbandry.
2. It further recommend that, some credit facility could be developed to support farmers to improve on the structures necessary to improve biosecurity levels in their farms and improve on the protection of the chicken from predators.
3. Provision of Extension messages should be channeled more through radio programmes and field days through which more farmers are reached.
4. Chicken producers should be trained on need to and methods of ensuring feeds and materials feed to chicken are not contaminated with pathogens and parasite eggs.
5. There is need for a policy on biosecurity in Livestock enterprises in Makueni County.

6.3 Suggestion for further studies

1. A study to establish the efficacy of the use of herbs (Aloe species, croton bark, Mexican marigold, hot pepper) to manage indigenous chicken diseases and parasites. These practices are widely used in Kikumini/Muvau ward.
2. A Study to establish the best way and the language to package and disseminate written extension materials to resource limited indigenous chicken producers.

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APPENDICES

APPENDIX I: FARMERS QUESTIONNAIRE

FARMERS' (HH) QUESTIONNAIRE

Notes to the Questionnaire Respondent;

This questionnaire is intended for academic research purpose and any information given will be treated with confidentiality, and will not be diverted for any other use**.** The findings will inform the government and other development agencies on ways to improve indigenous chicken productivity in this area. Your name will not be mentioned anywhere in the analysis either will it be used maliciously. Feel free to willingly give precise information as possible.

Name of Enumerator _____Tel._____

Date _____

SECTION A: GENERAL INFORMATION

1. Kindly fill the following
   i) Sub-County _____
   ii) Ward _____
   iii) Sub-location _____
   iv) Village _____
   v) GPS of the HH- Latitude _____Longitude_____
   Altitude _____ (above sea level)

2. Name of respondent_____ Mobile Tel. No_____

3. Respondent's position in the HH Head-Man [1] Wife [2] Son [3] Daughter [4] Others specify_____

4. Type of headship, Male headed [1], Female headed [2], Male child headed [3], Female child headed [4]

5. Please indicate your total household size _____

6. Average land size in (Acres) _____

7. Please indicate your age (how old are you)_____ Years

8. How long have you kept indigenous chicken? **(Indicate in full years)** _____

9. What is your highest level of education? **(Tick appropriately and write years)**
   i) No formal education _____
   ii) Years in Primary school education _____

iii) Years in secondary school education _____
iv) Years in vocational training _____
v) Diploma or Certificate level _____
vi) Degree and above _____

10. What are the sources of income for the household? **(More than one option allowed)**
[1] Employment [2] Business [3] Sell of crop [4] Sale of livestock
[5] Remittances [6] others please specify_____

11. Indicate the number of your livestock in the table below?

(Note: L-Local breed, E-Exotic breed, C-Crosses)

Livestock	**Breed**	**Number**
Cattle		L_____E_____ C_____
Goats		
Sheep		
Chicken		
Others (Specify)		

12. Why do you keep indigenous chicken? **(More than one option allowed)**
i) Provision of family food [1]
ii) Commercial selling [2]
iii) Subsistence [3]
iv) Hatchery [4]
v) Other reason please indicate_____

13. Classes of indigenous chicken kept: how many Cocks_____ Hens_____
Chicks_____ Growers_____ Pullets_____

14. Kindly indicate the method of raising your indigenous chicken
i) Intensive production [1]
ii) Complete free range [3]
iii) Semi free range [4]

SECTION B: CONSTRAINTS THAT AFFECTS THE PRODUCTIVITY OF INDIGENOUS CHICKEN IN THE STUDY AREA

15. What major challenges do you face in rearing your indigenous chicken?

i) _____

ii) _____

ii) _____

iv)_____

v) _____

vi)_____

16. How do you solve these challenges? (**Take time to probe)**

Challenge	Solution

17. a) Have you or any member of your HH been trained on Chicken management practices?

Yes [1] No [2]

b) If yes, when?

i) This year [1]
ii) Last year [2]
iii) Two years ago [3]
iv) More than three years ago [4]

c) Who was trained in your HH (**More than one option is allowed**)

HH head [1] Spouse [2] Child [3] Others, Specify _____

18. Has the training been of use to you? Yes [1] No [2]

19. Do you access extension services? [Yes]. [No]

20. How far from your HH is the nearest extension office? _____ (**in estimated Km**)

21. Who provides extension services in his area? **(More than one option is allowed)**
County DALF/GoK [1] NGOs [2] FBO [3] CBO [4]Community based SPs [5] Private SPs(Trained professionals) [6]

22. How do you receive extension messages on chicken production? (**More than one option is applicable)**

i) During field days/shows [1]
ii) During farmer field school sessions [2]
iii) During farm visits by extension officers [3]
iv) Listening to radio/TV programmes [4]
v) Reading written materials [5]
vi) Public Barazas [6]

23 a) Are you satisfied with the extension services you receive? Yes [1] No [2]

(a) If no, what could be the possible reasons why extension messages are not understood and adopted?

i) Language used is not understood [1]
ii) The messages a times are not directed to problem at hand [2]
iii) Low literacy level of the chicken producers [3]
iv) Low value attached to chicken [4]
v) The messages do not target the real care takers of chicken in terms of gender [5]
vi) Dissemination materials (brochures, pamphlets, booklets etc are expensive [6]

(b) Suggest ways that may improve on the dissemination of extension messages to chicken producers in order to enhance adoption

i) _____

ii) _____

iii) _____

iv) _____

v) _____

24. Please identify the major chicken diseases you have experienced in your farm **(They will answer in local language but you can capture in English)**

i) _____

ii) _____

iii) _____

iv) _____

v) _____

25. How do you manage the indigenous chicken diseases? **(More than one option is applicable)**

i) Use of herbs [1]
ii) Buy veterinary drugs and treat myself [2]
iii) Call veterinary officer [3]
iv) Selling [4]
v) Slaughtering [5]
vi) Vaccination [6]
vii) Do nothing [7]

26. How do you manage parasites infestation in indigenous chicken? _____

_____

27.a) Do you supplement your indigenous chicken? Yes [1] No [2]

b) If yes, how many times in a day_____

28. Please indicate the kind of feed you give your indigenous chicken **(More than one option is applicable)**

i) Commercial feed always [1]
ii) Grains from my farm [2]
iii) Mixing commercial feeds and grains from my farm [4]
iv) Food leftovers [5]
v) Formulate my poultry feed [6]
vi) Others please indicate _____

29. On your own opinion do you think the constraints you face affects the productivity of indigenous chicken in the your area?

i) Strongly disagree [1]
ii) Disagree [2]
iii) I don't know [3]
iv) Agree [4]
v) Strongly agree [5]

SECTION C: BIOSECURITY MEASURES

30. Indicate the type of your chicken housing structure **(More than one option is applicable)**

i) Permanent [1]
ii) Semi-permanent [2]
iii) Temporary [3]
Others, specify_____

31. If you house your chicken, does the unit meet the required conditions such as;

i) Ventilation_____
ii) Aeration _____
iii) Cleanliness _____
iv) Control of rodents _____
v) Control of wild birds _____
vi) Control of predators_____

(**Enumerator can observe/counter check all these if the unit is within reach)**

32. What kind of protection do you give to your chicken**(More than one option is applicable)**

i) Perimeter fence [1]
ii) Semi fenced [2]
iii) No fencing at all [3]

33. a) Are you aware of any disinfectants for use in poultry and poultry structures?

i) Yes [1]
ii) No [2]

b) If yes, which ones?,_____

c) If No, why haven't you used disinfectants? They are too expensive [1] They are inaccessible [2] They are toxic to chicken [3] Indigenous chicken have less economic value[4]. Others, specify_____

34. How do you ensure safety of the feeds you give to your chicken?
_____
_____
_____

35. How frequent do you clean feeders and drinkers. **(One option only)**

i) Daily [1]
ii) Every two days [2]

iii) Weekly [3]
iv) Every two weeks [4]
v) Monthly [5]
vi) Not cleaned [6]

36. Where is the source of your breeding stock? **(More than one option is applicable)**

i) I breed my own [1]
ii) From neighbours [2]
iii) From local mini hatcheries [3]
iv) From renowned (Bio secure) hatcheries [4]
v) From market [5]
vi) Any other source [6]

37. How do you ensure the breeding stock is free from diseases and parasites?_____
_____
_____

38. How do you transport your breeding flock from source to your farm?

i) By public vehicles [1]
ii) By private vehicles [2]
iii) By bicycle [3]
iv) By motor cycle [4]

Any other, please indicate _____

39. Which of the following animals do your indigenous chicken interact with? **(More than one option is applicable)**

i) Wild birds [1]
ii) Livestock [2]
iii) Other chicken from neighbour farms [3]
iv) Birds on transit for sale [4]

40. In your own opinion, do you think you have put in place adequate measures to control entry of diseases and parasites in your farm?

i) Strongly disagree [1]
ii) Disagree [2]
iii) I don't know [3]
iv) Agree [4]
v) Strongly agree [5]

SECTION D: SOCIO-ECONOMIC AND ECOLOGICAL DRIVERS THAT HINDER THE ADOPTION OF BIOSECURITY MEASURES.

41. Who owns the land you keep indigenous chicken

i) My Spouse [1]
ii) Communal family [2]
iii) Leased/Rented [3]
iv) Community [4]
v) Squatter
vi) Any other, please identify_____

42. Approximate what is the size of your indigenous chicken house **(approximate Dimensions in metres)** _____

43. A part from the way you deal with chicken diseases mentioned in question 26 above. How else do you ensure control of diseases and parasites in your indigenous chicken**? (More than one option is allowed)**

i) Getting breeding stock from disease free sources [1]
ii) Isolating all infected birds [2]
iii) Keeping different flocks of birds separately [3]
iv) Maintaining cleanliness in the chicken house [4]
v) Ensuring regular vaccination [5]
vi) Regular use of disinfectant [6]

44. Who decides when to buy drugs for your indigenous chicken? **(More than one option is applicable)**

i) Myself (Man) [1]
ii) Myself (Woman) [2]
iii) Both of us (Couple) [3]
iv) Our chicken attendant [4]
v) Professionals [5]

45. How many household members work in the chicken unit daily _____

46. (a) Do you use any method to control diseases when your indigenous chicken get sick? [1] Yes [1] No

(b) If **yes**, how do you do this? **(More than one option is allowed).**

Regular vaccination [1] Use of antibiotics in drinking water or in feeds [2] Cull sick birds immediately [3] Isolate all sick birds from the flock [4]
Others, please specify_____

(c) If **no,** what could be the reason **(More than one option is applicable)**

i) Lack of knowledge on how to control diseases [1]
ii) Inadequate of resources [2]
iii) They are resistant to infections [3]
iv) Not a priority [4]

47. Do you partner with other chicken farmers to ensure indigenous chicken diseases and parasites are controlled?

[1] Yes [2] No

48. How do you market your chicken (1) call middle traders to my farm (2) Take to market myself

49. a)Who owns chicken in this household? Children [1], Husband [2], Wife [3] , Family [4]

Any other specify _____

b) Does ownership cause any social challenges in the family _____

If yes, explain

_____
_____
_____
_____
_____

50. Describe in your perception how environment (Immediate surroundings, rain, temperature, water etc) has contributed to low chicken productivity in this area?

_____
_____
_____
_____

51. Give your general opinion on the future trend of indigenous chicken enterprise in your farm?

_____
_____
_____

Thank you for your time and your invaluable contribution

APPENDIX II: FOCUS GROUP DISCUSSION CHECK LIST

General information

- Need for a brief description of members of your community (resource poor/rich/subsistence farmers/commercial farmers, small scale/large-scale farmers***)(Categorization of the participants in to the levels mentioned above)***
- What major livelihood activities is the community involved in?
- Briefly describe the priority agricultural value chains the community is involved in
- Using pairwise ranking, this can be ranked in order of importance in terms of economic value and inclusivity of gender and vulnerable members of the community.
- What livestock species are reared within the community? Major ones.
- Using pairwise ranking, this can also be prioritized.

Poultry production practices

- Pick out chickens and find out the various breeds reared.
- What is the source of breeding stock of poultry in this area?
- Probe for reasons why there is preference for certain breeds and not others
- What is the average flock sizes/household?
- Describe how poultry is reared (production system) in this area- Free range, semi-intensive or intensive
- What are the main constraints of poultry productivity in this area
- Pairwise ranking to prioritize the constraints
- On average, how many eggs do chicken in this area lay per year?
- On average, how many eggs are incubated/hen/laying?
- How many are hatched per hen/incubation?
- Do farmers in this area have poultry housing units?
- Are the houses constructed to allow for proper ventilation, aeration and spacious room for regular cleaning?
- How are poultry houses cleaned?

- ❖ What biosecurity measures do farmers in this area employ for chicken production?
- ❖ Where no biosecurity is practiced, what are the main reasons for this?

Consumption preferences for poultry products

- Are there socio-cultural barriers which limit consumption of poultry meat and eggs in this area?
- Where there are socio-cultural believes, what products are consumed by:
    - Men
    - Women
    - Children

Tabulate this by Product, when and by who.

- ▪ When are chickens and chicken products most likely to be consumed in this area?
- ▪ On average, how many chickens will majority households in this area eat in a year?
- ▪ When are they likely to eat chicken meat?

Marketing practices

- Why do people in this area rear chickens?
- Where do farmers in this area sell their chickens?
- How much is fetched by the following products?

Poultry type/product	**Unit price (KES) farm gate**	**Unit price (KES) at the market /(shop)**
Eggs		
Day old Chicks		
Two weeks old chicks		
One month old chicks		
Growers		
Pullets		
Cockerels		
Hens		
Cocks		

- On average how many eggs and live birds are likely to be sold by a household in this area per year?
- What time of the year are chickens sold in mass in this area?
- Who buys your chickens? (Broker, farmers etc)

Special needs

As a group, do you have any special needs in relation to poultry rearing but different from what we have discussed above? Please list them

Suggest possible solutions to these (Tabulate Need and solution to this)

Special needs	**Possible/Suggested Solutions**

Thank you all for participating in this very important exercise to your area and to the county in general