CHALLENGES FACING CHICKEN PRODUCTION IN KATULANI DISTRICT, KITUI COUNTY

BY

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DECLARATION

I Mwobobia Royford Murangiri declare that this thesis is my original work and has not been presented for the award of a degree in any other university or any other award

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This work has been dedicated to my wife Joyce Wanja Irware for her support and encouragement throughout the study period.

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ABSTRACT

The poultry industry in Kenya is a key contributor to the local economy as well as food security and income with over 90% of households owning a flock of chicken (Kingori *et al*., 2010). The main objective of this study was to investigate the challenges faced by rural and peri urban chicken farmers in Katulani District, Kitui County. The study focussed on understanding the challenges affecting chicken farming, factors affecting technology adoption, access to institutional support services, choice of chicken health management strategies, flock structure and dynamics, in order to devise innovative approaches for promoting chicken industry in the study area. Data were collected through questionnaires, personal observations, photography and interviews on flock size, flock species and purpose, access to credit facilities and trainings. For this study, simple random sampling technique was used to select the respondents and data collected was analysed using Statistical Package for Social Sciences software. Over 80% of households kept indigenous chicken under free range using family labour, which were mainly reared for income and subsistence. Household size had influence on flock size with large households keeping larger flocks. There were more female headed households (59.1%) keeping chicken in the study area as compared to the males (40.1%). However, male headed households kept larger flock sizes in both study sites. Education levels had influence on flock size with peri urban areas having higher education levels (average of 10 years studying) and flock sizes compared to the rural households (average of 8 years studying). There were high levels of unemployment in both areas with those who were employed having higher flock sizes. Employment had a significant positive correlation ($p<0.05$, $r=0.643$) on purchasing power which was the main method of initial poultry acquisition. Approximately 84.5% of respondents earned their livelihood from mixed farming as compared to crop farming or livestock keeping in isolation with the employed having higher monthly incomes than from any farm related activities. Chicken contribute about 4.18% and 26.8% of total Tropical Livestock Units in rural and peri urban sites respectively with chicken, hens and pullets dominating the flock structure since they are mainly retained for production purposes. The cock to hen ratio was 1:2, i.e. one cock for every two hens. The main opportunities for chicken rearing in the study area were availability of land, water and labour while the main challenges were diseases, predators, limited poultry production skills and high cost of drugs/vaccines. There were low adoption of all chicken rearing technologies in both rural and peri urban areas; while the latter had higher technology adoption rates. Most of the farmers reported disease incidences in their farms especially Newcastle (NCD) and coccidiosis. About 98.6% and 90% of rural and peri urban respondents applied medicines to manage these diseases with rural farmers mostly using traditional medicinal products (80%) and peri urban farmers mostly using conventional medicines (58%). The main traditional medicinal products used were Aloe vera, neem tree, pepper and goat milk. Healing ability, availability of drugs, culture and cost of drugs were the main factors guiding the choice of drugs used by farmers. Therefore, a chicken disease control programme specific to the area which is lacking should be put in place. Also a review of extension models according to farmers needs should be put in place. Chicken farmers should be encouraged to form farmer groups for ease of accessing various types of services and bargaining power. Since ethno veterinary medicine and practice is widespread in this community, there is a need to improve veterinary services by integrating modern medicine with some of the used ethno veterinary medicine subject to validation.

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ABBREVIATIONS AND ACRONYMS

AHA	Animal Health Assistant
ANOVA	Analysis of Variance
ASALs	Arid and Semi-Arid Lands
DF	Degrees of Freedom
DFID	Department for International Development
DVO	District Veterinary Officer
EVM	Ethno Veterinary Medicine
FAO	Food and Agricultural Organisation
GDP	Gross Domestic Product
H1N1	Influenza A Virus Subtype
HPAI	Highly Pathogenic Avian Influenza
IFPRI	International Food Policy Research Institute
KARI	Kenya Agricultural Research Institute
KNBS	Kenya National Bureau of Statistics
NGO	Non-Governmental Organisation
OIE	Office International des Epizooties
SPS	Sanitary and Phytosanitary Agreement of the World Trade Organisation
SPSS	Statistical Package for Social Scientist
TLU	Tropical Livestock Unit
WTO	World Trade Organisation

CHAPTER 1: INTRODUCTION

1.1 Background of the Study

Agriculture contributes about to 26% of annual gross domestic product (GDP) in Kenya with poultry contributing 30% of the agricultural GDP (FAO, 2008; GOK, 2010). Majority of the rural populations in the developing world keep a flock of poultry either in free range or confined system (FAO, 2009; IFPRI, 2010). Chicken (Gallus domesticus) dominates most of the rural areas in the developing world (FAO, 2009) with 80% and 20% of chickens in Kenya being of indigenous and exotic types respectively (GOK, 2009). Kitui County constitutes 2.76% of the total Kenyan population of indigenous chickens (Table 2). Other poultry species include ducks, geese, pigeons and guinea fowls.

This study focussed on chicken rearing because of their resilience to harsh climate, need for less space and they are the most preferred and widely kept by the majority of Kenyan population. Therefore they form an important component of rural livelihoods. In Kenya, indigenous chicken flocks were estimated at about 25.7 million (GOK, 2009) and are kept by about 90% of the population in the rural areas in small flock of up to 30 birds mainly under free range system (Kingori *et al*., 2010; Kirwa *et al*., 2010). Chicken are family owned and managed mostly by women and children (FAO, 2009). Their products are used for home consumption, as gifts, religious purposes or are sold to earn some income to buy basic household food items (FAO, 2009). With the rapidly growing human populations, demand for high quality food especially protein; improving income levels and standards of living have all created a high demand for chicken products.

Despite the growing demand, chicken face several challenges namely; 1) production related which include diseases, predators, theft, harsh environment, lack of and/or inadequate production skills, poor nutrition, high feed costs, flock sizes and marketing (KARI, 2006; Kirwa *et al*., 2010; Ochieng *et al*., 2013); 2) Adoption of various management interventions like feed supplementation, vaccination, brooding, housing and labour (Ochieng *et al*., 2013). For example, under free range production system, which is commonly practised in Kitui County, chicken are rarely vaccinated or treated against diseases and parasites (FAO, 2009). Besides, different poultry species are kept

together hence failure to take into consideration the bird specific nutrition requirement resulting in low production. Under free range system, chicken are left to scavenge and may be easily infected and also spread the disease to the rest of the flock (FAO, 2009; 3) Institutional support to farmers like limited access to: extension services, veterinary services, credit facilities, trainings, access to markets and market information and group memberships (Ochieng *et al*., 2013).

(4) Low awareness levels among chicken farmers on common poultry diseases especially potential zoonotic diseases and more so the emerging diseases like Highly Pathogenic Avian Influenza (HPAI), (FAO, 2009). A study done in Kenya by FAO, (2008) had recommended that public education and training on safe poultry production, good bio-security and management was critical for rural areas. However, limited studies have been conducted to establish these challenges among chicken farmers in Kitui County. Since chicken diseases are a constraint to production in terms of cost and time, it is important to understand how farmers respond to these diseases. Smallholder chicken farmers under free range production system respond differently in times of disease occurrence; they may choose to; do nothing, use ethno-veterinary medicine, use modern (conventional) medicine and/or human medicine (Mapiye and Sibanda, 2005).

Failure by farmers to respond to disease incidences was attributed to inadequate cash to purchase veterinary drugs and shortage of veterinary extension services, while traditional medicine are often used and preferred due to their low cost, ease of application and local availability. The type of medication used is important since conventional medicine have been tested and evaluated for efficacy and side effects while traditional medicine are centred on activating the body's own natural healing ability but have not been tested or evaluated (Mapiye and Sibanda, 2005). This threatens the quality of chicken meat and eggs, thus a health hazard.

1.2 Statement of the Problem and Significance of the Study

This study focuses on chicken rearing since they are kept by about 90% of Kenyan population (Kingori *et al.*, 2010). They play a great role socially, economically and nutritionally to chicken farming households. Despite this potential, several challenges face the sector and continue to reduce these benefits through low production levels and subsequent economic losses. Chicken are said to be appropriate in rural areas because they require minimum inputs which rural farmers can easily afford leading to a significant contribution to food security and poverty reduction. Therefore, the significance of this study is to shed light on challenges facing chicken farmers and propose innovative approaches to address these challenges and maximise opportunities for enhanced productivity and improved livelihoods.

1.3 Research Objectives

1.3.1 General Objective

To identify challenges and opportunities facing chicken production and management in Katulani District, Kitui County.

1.3.2 Specific Objectives

i. To establish and prioritize factors influencing chicken rearing in Katulani District, Kitui County.
ii. To establish factors influencing the adoption of various chicken management technologies and innovations in Katulani District, Kitui County.
iii. To determine the existing chicken production systems including distribution and flock size among farmers in Katulani District, Kitui County.
iv. To determine factors influencing farmer's choice of chicken health management strategies (traditional and conventional) in Katulani District, Kitui County.

1.4 Research Questions

i. What factors influence chicken rearing in Katulani District, Kitui County?
ii. What factors influence the adoption of various chicken management technologies and innovations in Katulani District, Kitui County?

iii. What are the existing chicken production systems in terms of distribution and flock size in Katulani District, Kitui County?

iv. What factors influence farmer's choice of health management strategies for chicken diseases?

1.5 Justification

Several challenges facing farmers result in reduction in chicken numbers productivity in a household and therefore impact on the food security of the farmer (FAO, 2008). This is a major setback in increasing food production and improving the livelihood of Kenyans as the human population increases. The rapidly growing human population, income levels and diet choices (white meat) have led to increased demand for chicken and its products. Increased human population has also led to land subdivision, chicken are therefore an ideal entry point since they require less space.

Small holder chicken rearing is an ideal entry point as a potential tool for poverty reduction, improvement of household food security and nutrition when adopted as an alternative land use option. In addition, the study area experiences perennial droughts and this makes the area unsuitable for other agricultural activities especially the ones dependent on rain. This makes chicken rearing an alternative since it is not climate dependent and chicken can tolerate harsh weather. Besides, over 90% of rural households own a flock of poultry, making poultry integral part of household income. It is therefore important that challenges and opportunities facing farmers are understood and information generated to guide policy formulation, service provision and create innovative approaches for solving the challenges and maximising the opportunities.

CHAPTER 2: LITERATURE REVIEW

2.1 Background Information

The word poultry is applicable to bird species raised in most countries including Kenya for meat and eggs (Oyeyinka *et al*., 2012). They include chicken, ducks, turkeys, pigeons, ostriches, guinea fowls and quails. The main genotypes of commercial layers are Shaver Star cross, Isa Brown and Ross, while commercial broiler genotypes include Arbor Acres, Hybro, Cobb (United Kingdom) and Hype co (Holland). Indigenous chicken genotypes include the Rhode Island Red, Light Sussex, New Hampshire Red, Black Australorps, White Leghorns, Plymouth Rock, Barred Rock and Buff Rock (FAO, 2008).

There are two types of turkeys; local small bronze and buff type and the commercial large white and buff types. Ducks are of the Muscovy type while guinea fowls are the helmeted type (FAO, 2008). The poultry sector employs people either directly in production and marketing or indirectly through linkages with suppliers of such inputs as day-old chicks, feed and veterinary services (Omiti and Okuthe, 2008). The sector also contributes to food security throughout the developing countries by diversifying and improving incomes, food quality, energy and fertilizer in over 80% of rural households (FAO, 2004). Poultry also play important social and cultural roles among communities (FAO, 2009). Of all the poultry classes, chicken (Gallus domesticus) dominates the smallholder poultry production systems in Kenya with a total population of 31.8 million including exotic and indigenous breeds (GOK, 2009).

Indigenous chicken are mainly reared in the rural areas while commercial birds (broilers and layers) are kept in urban or peri urban areas of main centers, such as Nairobi, Kisumu, Nakuru and Mombasa where access to markets is guaranteed (Omiti and Okuthe, 2008; FAO, 2008). Chicken are easier and cheaper to start rearing than other types of livestock which require a large start-up capital more so in the rural areas where chicken are reared under freehold , they scavenge for food during the day and are housed in the night to escape predators and harsh weather. This is therefore a low input enterprise for the farmers. Therefore anything that impacts adversely on the chicken affects the livelihood of the farmers and consequently food security (FAO, 2008). Table 1 shows chicken populations across East African Community (EAC).

Table 1: Chicken populations by country, 000 head from 2009-2013

Livestock	Partner state	2009	2010	2011	2012	2013
Chicken	Burundi	1,591	1,719	1,857	2449	2571
	Tanzania	58,000	58,000	42,667	42,667	66,000
	Uganda	39,290	43,201	47,520	36,956	38,064
	Kenya	31,800	31,800	31,800	31,800	31,800
	Rwanda	2,848	4,081	4,420	4,688	4,803
	Totals	132,796	135,314	121,649	118,560	143,238

Source: East African Community portal (www.eac.int/): accessed on 27th June 2015.

From Table 1 above, chicken population across East Africa Region had a zigzag trend from 2009 to 2013. In Burundi and Rwanda, the chicken population was increasing throughout the period. In Kenya, the population was constant while in Tanzania and Uganda the population had a zigzag trend. Chicken contribute significantly in the rural trade, welfare and food security especially in small holder farms where an average household keeps 13 birds per flock in Kenya (FAO, 2008).

Table 2: Chicken populations by type and County

S/No	County	Indigenous chicken		Commercial chicken	
		Population	National %	Population	National %
1	Baringo	392,298	1.52	38,152	0.63
2	Bomet	694,599	2.7	39,422	0.65
3	Bungoma	1,192,446	4.63	63,394	1.04
4	Busia	869,695	3.38	42,799	0.7
5	ElgeyoMarakwet	309,633	1.2	28,744	0.47
6	Embu	436,899	1.7	67,892	1.12
7	Garrisa	82,127	0.32	22,168	0.37
8	Homabay	1,094,776	4.25	55,801	18.03
9	Isiolo	35,137	0.14	6,652	0.11
10	Kajiado	267,913	1.04	276,291	4.55
11	Kakamega	1,604,159	6.23	120,012	1.98
12	Kericho	409,727	1.6	43,810	0.72
13	Kiambu	801,072	3.11	1,686,565	27.78
14	Kilifi	655266	2.54	176740	2.91
15	Kirinyaga	465,455	1.8	82,458	1.36
16	Kisii	1,026,431	3.99	123,760	2.04
17	Kisumu	852,495	3.31	127,464	2.1

18	Kitui	711,182	2.76	44,238	0.73
19	Kwale	433,827	1.68	98,220	1.62
20	Laikipia	318,125	1.24	41,847	0.69
21	Lamu	87,951	0.34	7,636	0.13
22	Machakos	862,592	3.35	182,952	3.01
23	Makueni	762,778	2.96	46,027	0.76
24	Mandera	200,662	0.78	27,008	0.44
25	Marsabit	46,308	1.8	4,382	0.07
26	Meru	111,7305	4.34	186,977	3.08
27	Migori	1,285,736	5	88,182	1.45
28	Mombasa	101,418	0.39	189,427	3.12
29	Muranga	682,752	2.65	515,090	8.48
30	Nairobi	279,397	1.08	342,788	5.65
31	Nakuru	1,102,321	4.28	428,484	7.06
32	Nandi	600,613	2.3	41,846	0.69
33	Narok	561,319	2.18	37,523	0.62
34	Nyamira	351,793	1.37	53,081	0.87
35	Nyandarua	576,870	2.24	53,344	0.88
36	Nyeri	513,637	2	152,380	2.51
37	Samburu	37,749	0.15	4,962	0.08
38	Siaya	994,247	3.86	52,768	0.87
39	TaitaTaveta	212,129	0.82	38,235	0.63
40	Tanariver	109,105	0.42	11,606	0.19
41	TharakaNithi	135,417	0.53	5,692	0.09
42	Trans Nzoia	630,615	2.45	161,455	2.66
43	Turkana	165,349	0.64	15,444	0.25
44	UasinGishu	664,005	2.58	159,333	2.62
45	Vihiga	478,051	1.86	33,772	0.56
46	Wajir	140,110	0.54	22,137	0.36
47	West Pokot	402,996	1.56	22,052	0.36
	TOTAL	25,756,487	100 %	6,071,042	100%

Source: GOK (2009) Kenya National Bureau of Statistics 2009 Census

From Table 2 above, total chicken population was 31,827,529; Indigenous chicken population was 25,756,487 representing 80.9% of total population. While commercial chicken population was 6,071,042 representing 19.1% of total population. Indigenous chicken are the majority as they are cheap, easy to rear and manage and this has led to a lot of interest in their production at village level as well as peri urban and urban areas throughout the developing world (FAO, 2009). From the table, Kitui County contributes to 2.76% and 0.73% of the national indigenous and exotic chicken

population respectively. Kitui County also ranks number 13 and 26 nationally in populations of indigenous and commercial chicken respectively.

Table 3: Indigenous and exotic chicken distribution in selected districts in Kitui

District	Indigenous chicken	Exotic chicken
Kyuso	78526(10.87)*	3371(8.22)
Kitui	370942(52.17)	31868(71.23)
Mwingi	144292(20.29)	5249(12.33)
Mutomo	117422(16.67)	3750(8.22)
TOTAL	711,182(100)	44,238(100)

**Figures in brackets are in percentages*

Source: (GOK, 2009) Kenya National Bureau of Statistics 2009 census

Table 3 indicates indigenous and exotic chicken population distribution among various districts in Kitui County. Kitui District (where the study area falls) constituted 52.17% and 71.23% of Kitui County indigenous and exotic chicken population respectively. This is higher compared to all other districts in the County. Kitui is a semi-arid area where crop farming is unsustainable due to unreliable and insufficient rainfall leading to recurrent crop failure. In addition, the dry weather in unable to support other agricultural activities requiring sufficient rains. Therefore chicken provide an alternative land use option since they are more resilient to climate variability. This information supports FAO (2008) which noted that the arid and semi-arid and neighbouring districts of Kitui, Makueni, Mwingi and Machakos have the highest concentration of indigenous chicken.

2.2 Chicken Management Interventions and Strategies

Management interventions are technologies and innovations used by chicken farmers to improve the production and profitability of their chicken enterprises. They include proper housing, feed supplementation, vaccination; brooding and predator control (Ochieng *et al*., 2013). These technologies influence the level of output, product quality, employment, trade and benefits (Teklewold *et al*., 2006), thereby increasing the income generating capacities of the farmers. The technologies also allow farmers

to rear genetically improved chicken which are generally more productive and also use locally available feed resources to formulate diets that are nutritionally balanced.

2.2.1 Brooding

A brooder is where young day old chicks are put to start growing. It should be warmed to between 38-40 degrees Celsius using charcoal burners or infra-red bulbs to provide heat to chicks, since at that age the chicks are not able to regulate their own body temperature due to undeveloped feather coat. The brooder should be heated before the arrival of the chicks (Maina, 2008). On arrival the chicks should be provided with a mixture of glucose and vitamins dissolved in warm water to revitalize them in case they are tired. Feed should be sprinkled on the surface of clean newspapers to stimulate feeding. After three days the chicks should be introduced to feeding from feeders. Few drops of liquid paraffin should also be added in drinking water for the first few days to aid in defecation (Maina, 2008).

2.2.2 Shelter

Chickens need a good shelter; therefore they should be housed to protect them from bad weather, predators and thieves. A shelter allows farmers to inspect and handle chicken to see if any is sick or needs attention and collects eggs from the same place. It should be built on a shady, dry, safe place and the size depends on the number of chicken kept. It should have a secure door, allow plenty of light and air movement and designed to put into consideration the needs of the chicken and the people operating, it should be labour efficient and reasonable in investment. Chicken houses can either be semi intensive, deep litter, slatted or wire floor, a combination of slated and deep litter and cage or battery system. There should be perches, feeders, drinkers and the house always kept clean (FAO, 2008; FAO, 2009).

2.2.3 Predators

Predation is more common in free range chicken due to tendency of farmers to let their chicks scavenge with the mother hen from the first day due to increased feed cost in confined systems. With predators such as snakes, rats, dogs, cats and birds of prey as the main causes of losses especially in young birds, controlling them either by

housing, trapping, hunting or using repellents are technologies farmers have adopted (Berg, 2001).

2.2.4 Vaccination

A vaccine is a biological preparation that provides active acquired immunity to a particular disease. Active immunization involves administration of antigen(s) derived from an infectious agent so that the chicken gets an acquired immune response and achieves resistance to that agent. When properly used, vaccines are highly effective in controlling infectious chicken diseases. In chicken, entire flock vaccination is encouraged as it results in increased resistance of a flock due to presence of immunity within the group, thus reduces the probability of a susceptible chicken being infected. As a result, spread of infectious disease is slowed or blocked (Merck's manual, 2006). Farmers should therefore adopt this disease control strategy, more so for Newcastle Disease (NCD) which kills on average 70-80% of unvaccinated free ranging chicken. The reason for low poultry vaccination rates in most developing countries is because of the following reasons; majority are reared under free range and therefore difficult to group together an adequate (large) number in order to obtain an efficient vaccination rate, raising chicken of varying ages together therefore requiring different vaccine regimes and the need to maintain a cold chain for vaccine storage throughout (Branckaert *et al.,* 2000).

2.2.5 Feed Supplementation

Feed supplementation is necessary to allow for maximum production of meat and eggs from chicken. This is especially in free range chickens which usually starve out during the dry season as a result of diminishing feed resource base (Scavengeable Feed Resource Base). Inadequate feed and water also reduces the chicken's resistance to diseases and parasites. The best way to supplement chicken is by use of local feed resources; also pre-mixed supplementary feed from the market can be used (FAO, 2009).

2.3 Institutional Support to Farmers

Institutional support to chicken farmers include extension and veterinary services, credit facilities, training, access to market, market information and group membership.

2.3.1 Farmer Groups

Membership to farmer groups facilitate easier access to inputs like feed supplements, improved chicks, drugs and vaccines, technical advice, credit, training, transportation and marketing of chicken products (Branckaert *et al*., 2000). Organising poultry farmers into groups has not been easy especially among free range chicken keepers since flock sizes are small and chicken are maintained with minimal labour and capital inputs. This means that this farming system is considered by farmers as secondary occupation compared with other activities like crops farming and trade. Nevertheless, it is essential that farmers are encouraged to initiate chicken farming using medium sized flocks (Branckaert *et al*., 2000).

2.3.2 Veterinary Services

Veterinary care especially to chicks is one of the most important factors affecting chicken production; it helps in detecting and treatment of any kind of disease at an early stage. To protect and increase the immunity of chicken, they should be vaccinated against all locally important diseases at the recommended periods (Grepay, 2009).

2.3.3 Credit

Limited access to credit is universally indicated as a key problem for chicken farmers in Kenya. This affects technology choice by limiting the number of alternative technologies and innovations considered for adoption, it forces farmers to rely on self-financing or borrowing from friends or relatives. Besides lack of access to long term credit also forces farmers to rely on high cost short term finance. In addition, other financial challenges facing farmers in Kenya include the high cost of credit and high bank transaction costs (Munyaka, 2010).

2.3.4 Training

Education and relevant skills are important in running any business enterprise. Chicken farmers should therefore be trained in the following areas i.e. disease and predator control, proper housing, use of equipment, entrepreneurship, feeding, value addition, record keeping, budgeting, genetic improvement, marketing and the basic understanding of the chicken anatomy and physiology. The trainings should preferably be conducted on-farm. In addition, local craftsmen should be trained to manufacture small equipment like feeders and drinkers (Branckaert *et al*., 2000). The trainings should be conducted by qualified and experienced personnel such as extension staff and training institutes taking into consideration household and community levels (Mapiye *et al*., 2008).

2.3.5 Marketing

Access to market and market information also poses a challenge to farmers especially those in rural areas. The market prices are mostly demand driven with local purchases and middlemen being the main outlets, mainly for local consumption or restocking. Pricing mechanism is on bargain basis and prices are based on size and condition of the bird. Bird size is used to estimate weight with middlemen using hand weighing estimation to exploit producers (Danda *et al*., 2010).

Despite the availability and possibility of accessing national and international databases, lack of sufficient market information has been a setback to chicken farmers with most farmers relying on private or even physical contacts for market related information. This is mostly attributed to poor telecommunication infrastructure in rural areas (Munyaka, 2010).

2.4 Flock Structure and Dynamics

Flock structure entails number of chicks, pullets, hens, cockerels, cocks and the entire flock size. Flock dynamics includes type of production system, source of chicks, purpose of keeping chicken and source of initial breeding stock.

2.4.1 Flock Structure

For the success of a chicken rearing enterprise, it is necessary to use stock proven to be of good quality and of the appropriate genotype for the product to be produced. The first decision is to choose meat type for meat production and egg type for egg production. Having made the decision, the next step is to analyse the production system and market to select a genotype that suits the production system and produces a product suitable for the market. The size of the flock should always match the size of the house, the amount of feed one can produce or afford to buy, and the feed resources in the environment (scavenging feed resource base). The surplus cocks should be sold to prevent them from eating the scarce feed resources, to increase efficiency as well as prevent them from fighting and stressing the hens (FAO, 2009).

2.4.2 Production System

Poultry production systems are usually categorised into four types; 1) the large scale integrated commercial system common in breeding flocks; 2) the large scale producing system with over 10,000 chickens; 3) the small scale commercial system with hybrid chickens referred as small scale confined system and finally; 4) the backyard production system with indigenous chicken commonly referred to as traditional free range (FAO, 2009; Moreki, 2010).

2.4.3 Source of Chicks

Chicks can either be sourced from hybrid strains in well managed hatcheries and parent stock or from indigenous/ local breeds. Local breeds are usually selected for their hardiness and sometimes meat production but not for egg production, their hens are good hatchers but poor layers. Comparatively, hybrid strains are more productive and suitable for more intensive poultry production system (Branckaert *et al*., 2000).

2.5 Chicken Production Constraints

The chicken production constraints include use of poor quality and high cost feed rations, lack of disease and predator control, harsh environment and limited production skills (Ochieng *et al*., 2013). Any improvements in these constraints may lead to sustainable increase in chicken productivity.

2.5.1 Feeds

Feed contribute to 70% of total variable cost of chicken rearing and therefore greatly influencing the economics of chicken production management. It not only affects the quantity of chicken products but their quality. A proper feeding program should result in less quantity of feed consumed at an affordable price to give the highest quantity and quality products hence giving the highest profits. Although each poultry strain bears its special feed conversion efficiency and characteristics, the right feed is an important factor to support such efficiency; on the same note, chicken feed differ depending on the purpose, type and class of chicken kept. For example feed needs of layers differ with those of broilers (Grepay, 2009). It is recommended that farmers use locally available feed resources to formulate balanced diets (Branckaert *et al.*, 2000). Chicken are able to obtain some of their nutrients from insects, worms, and plants when on pasture, thus reducing feeding costs.

2.5.2 Diseases and Predation

The presence of disease in a chicken flock is reflected by inferior performance. It is therefore essential that the flock is in good health to achieve their performance potential. There are three elements of good health management of a chicken flock. These are: prevention, early recognition and early treatment of the diseases. Disease prevention is a more economical way of health management than waiting for the early recognition and treatment (FAO, 2009). A majority of chicken diseases can be prevented by timely vaccinations. Although it has been difficult to organize vaccination campaigns covering free range chickens due to the following reasons; the difficulty in grouping together an adequate (large) group of chicken in order to achieve an efficient vaccination rate, raising of different aged chicken together and the requirement to maintain cold chain for proper vaccine storage. Predators should be controlled by housing, trapping, hunting and use of repellants (Branckaert *et al*., 2000).

Generally there are ten simple rules for disease control; (i) Providing the right feed and clean water, (ii) Shelter built against wind and rain, (iii) Regular house cleaning, (iv) Providing dry litter, (v) Proper stocking rates, (vi) Separating different chicken classes based on age and health status, (vii) Vaccination and revaccination if

necessary, (viii) Isolation and treatment of the sick (ix) If no medication is available, the sick should be killed and burned or (x) Buried (FAO, 2009).

2.5.3 Harsh Environment

A harsh environment is defined as one that is outside of the comfort range of chicken (www.poultryhub.org (2014). In this context high and low temperature, high humidity, excessively strong wind, inadequate ventilation and/or air movement and high levels of harmful air pollutants such as ammonia are examples of a harsh environment. Much effort should be made in designing and building chicken houses that will permit the regulation of the environment to a significant degree. It is the responsibility of those in charge and responsible for the day-to-day management of chicken, that the environment be controlled as efficiently as possible.

To this end, a good knowledge of the different factors that constitute the environment and how they interact with each other to influence actual conditions in the house and, more importantly, what measures to be taken to improve the house environment *(www.poultryhub.org* (2014). Harsh weather usually results in a huge shortage of scavengeable feed due to shortage of insects and green material. This makes chicken to depend on the owner for survival (Petrus *et al*., 2011).

2.6 Awareness of Common Chicken Diseases

Farmers should be aware of normal chicken behaviour, daily rhythm, natural incubation and hatching, management of young chicks, housing, hygiene, feeding, watering and healthcare (FAO, 2009). This allows production to be kept at optimum levels in line with proper management practices (Kingori *et al*., 2010). Farmers should also be aware of common chicken diseases as they cause death, unthriftness and lowered production. There are four main types of diseases affecting chicken: metabolic and nutritional diseases; infectious diseases; parasitic diseases; and behavioural diseases.

2.6.1 Metabolic and Nutritional Conditions

Metabolic and nutritional conditions are caused by a disturbance of normal metabolic functions either through a genetic defect, inadequate or inappropriate nutrition or impaired nutrient utilisation; an example is rickets and cage layer fatigue.

2.6.2 Infectious Diseases

An infectious disease is any disease caused by invasion of chicken by a pathogen which subsequently grows and multiplies in the body. Infectious diseases are often contagious, which means that they can be spread directly or indirectly from one chicken to another. Examples include avian influenza, fowl cholera (or Pasteurellosis), fowl pox, infectious bronchitis, infectious bursal disease (or gumboro), infectious coryza, infectious laryngotracheitis, Newcastle disease and salmonellosis.

2.6.3 Parasitic Conditions

Parasitic diseases are infections or infestations with parasitic organisms. They are often contracted through contact with an intermediate vector, but may also occur as the result of direct exposure. A parasite is an organism that lives in or on, and takes its nourishment from, another organism. They cannot live independently; they include coccidiosis, histomoniasis, lice, mites and helminths.

2.6.4 Behavioural Diseases

Behavioural diseases are as a result of abnormal behavioural patterns that lead to injury or ill health of the abnormally behaving chicken and/or its companions, an example is cannibalism *(www.poultryhub.org (2014).*

The most important diseases which affect chickens are viral diseases. Newcastle disease (NCD) is the most devastating, especially in unvaccinated village chickens. Others are fowl pox and infectious bursal disease where the later has become a very important disease in small scale confined systems and to some extent free-range systems. The frequently encountered bacterial diseases are fowl typhoid, fowl cholera, infectious coryza and pullorum disease. Ecto and endo-parasitic diseases are frequently seen among both village and commercial chickens. Helminthes account for

most of the parasitic diseases. Ecto-parasites are most prevalent among village chickens and include fleas, lice, and mites. Ticks are less common (FAO, 2009).

Increasing awareness on detection and treatment of these diseases leads to better welfare standards and increased production (Laura and Blake, 2012). All farmers should therefore be empowered and trained to recognise and report disease incidences since good surveillance is a vital tool in controlling chicken diseases. Disease reporting is important due to losses and welfare issues arising from their effects. For example, an endoparasite like ascaridia galli causes emaciation, diarrhoea, weakness and in large numbers lead to intestinal obstruction. Similarly, coccidiosis causes haemorrhage and thickened intestinal wall thereby compromising carcass weight and feed conversion efficiency.

FAO (2009) noted that improving on the care and vaccination of chicks against diseases such as Newcastle and fowl pox can minimize losses. Farmers should be advised against buying chicken at live bird markets or from unknown sources especially during outbreaks. Vaccination is recommended against all locally important diseases to all chicken, in addition, isolation of sick chicken and treatments are fundamental. If there are dead birds they should be burnt or buried deep enough about one metre deep to prevent animals from digging them up and spreading diseases. If chicken are sick, definitive diagnosis should be arrived at before vaccinating or introducing new flock. In rural areas farmers may not be aware that certain diseases such as Newcastle can be prevented by vaccination (Kingori *et al*., 2010).

2.7 Poultry Medications

Medication is any substance administered by mouth, applied to the body or introduced into the body for the purpose of treatment (Oxford dictionary, 2002). Table 4 shows various diseases or conditions and therapeutic agents used for their management. If a disease infects a flock, it is important that an appropriate treatment be commenced as soon as possible. This can only be achieved when the correct diagnosis has been made at an early stage. It is recommended that all field diagnosis i.e. a farm autopsy, be supported by a laboratory examination to confirm the field diagnosis as well as to ensure that other conditions are not also involved. Most treatments should be administered under the guidance of the regular flock veterinarian (FAO, 2009).

Table 4: Various disease conditions and their therapeutic agents

Disease or Condition	Therapeutic agent
Worms	Anthelmintics (dewormer)
Bacteria	Antibiotics
Coccidia	Coccidiostats
Fungi	Antifungal
Lice and mites	Insecticides/Acaricides
Vitamin/Mineral deficiencies	Vitamin/Mineral supplements

Source: Tablante, 2010.

During the14th World Organisation For Animal Health (OIE) conference held in Tanzania in 2001, it was noted that the use of drugs in animals is beneficial by keeping them healthy and well through relief of pain and suffering, they also help to control animal infections that could be passed on to humans. However guidelines on drug administration, dosage, and route of administration, withdrawal period and disposal of unused packages should be followed according to manufacturer's instructions (Andrews, 2000). Antimicrobials should be administered to compliment good management practice, vaccination programmes and site hygiene.

Disease control in poultry involves reducing susceptibility to infection through proper antimicrobial use and proper parasite control, increasing resistance by vaccination and decreasing exposure to pathogens such as bacteria, viruses, and coccidia. However concerns are arising due to improper handling and use of antimicrobials, feed additives, and hormones and pesticides leading to development of resistant bacteria, it is therefore recommended that use of other means like improved animal husbandry and hygiene, routine health monitoring and vaccinations should be considered before antimicrobial therapy (Andrews, 2000).

Turkson (2008) found in Accra, Ghana that most of drugs used by farmers were dewormers, coccidicidals and antibacterials' excluding vitamin and mineral supplements, yet information on which drug to buy is normally acquired from veterinarians, veterinary technicians, drug sellers, other farmers and self-experience and no withdrawal periods observed after administration.

Some poor rural chicken farmers also consider these antimicrobials as expensive and unaffordable (Marizvikuru *et al*., 2005), hence prompting the farmers to use ethno veterinary medicines which they consider as easily accessible, affordable and apparently effective (Gueye, 1999; Moreki, 2012). Use of medicines is among multidisciplinary approach measures of disease control in addition to culling, vaccination, quarantine, biosecurity and sources of introductions (Karin and Jonathan, 2007). Simple medical control measures recommended for use in the small scale rural chicken include vaccinations against NCD, fowl pox and gumboro; regular deworming with a broad spectrum dewormer (like piperazine) added to drinking water and control of all external parasites by use of acaricides, insecticides or dusting powders (FAO, 2009). Antibiotics are not effective against viral infections (Tablante, 2010).

CHAPTER 3: RESEARCH METHODOLOGY

3.1 Study Area

This study was carried out in Katulani District of Kitui County. It was chosen as it had two poultry markets, constitutes both peri urban and rural populations and its close proximity to Kitui town ensuring a ready market. The study is therefore giving insights on peri urban and rural chicken rearing. It is located along latitude -1.4167° and longitude 38.0000° (in decimal degrees). It borders Kisasi District to the east, Kitui Central and Matinyani to the west and Lower Yatta District to the south.

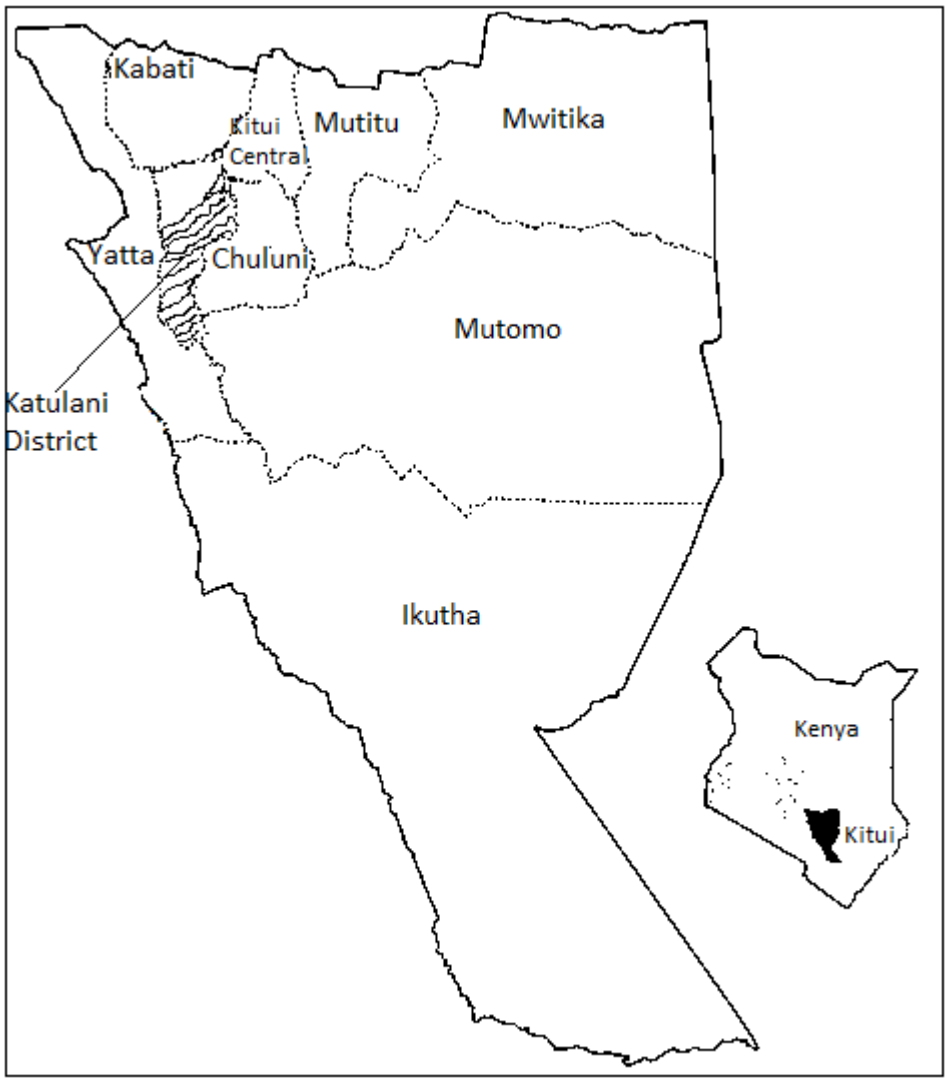

Figure 1: Location of Katulani District within Kitui County.

It covers an area of 330.4 square km with a population of 45,042 persons according to the KNBS, 2009 population and housing census (GOK, 2009). The district is normally warm and dry for most months of the year with temperatures ranging between 20ºC and 35ºC and experiences bimodal pattern of rainfall with long rains during April to June and short rains in October to December. The average annual rainfall is between 250 mm to 350 mm per annum (GOK, 2014). The area falls in Agro-ecological zones IV and V. The vegetation ranges from scrubland to thorny thickets. The district is served by seasonal rivers which dry after the rains. The other sources of water are shallow wells, pans, dams and boreholes. The pans and dams dry up during the dry season (DAO Katulani, 2012). Also some parts of the district are supplied with piped treated water from Masinga Dam by the Kitui Water and Sewerage Company. Cattle, sheep, goats, poultry and donkeys are the main livestock kept.

3.2 Target Population

This study focused on chicken farming households within Katulani District-Kitui County

3.3 Sample Size

The population of the study area was 45,042 persons (GOK, 2009) comprising of approximately 9,593 households. A proposed sample size was calculated based on the formula used by Israel (1992) and assuming 95% confidence level and p = 0.5

$$n = \frac{N}{1 + N(e)2} = \frac{9593}{1 + 9593(0.1)2} = 99$$

Where

n= was the sample size

N= was the number of households' within Katulani District (sampling frame)

e =is the level of precision/sampling error. 10% was used.

P=degree of variability. 0.5 was assumed as maximum variability in the population

Additional 10% respondents were included to cater for attrition, thus the total number of respondents was 110.

3.4 Research Design

A cross section survey research design was used for this study. Both qualitative and quantitative data were collected. Questionnaires were administered to 110 chicken rearing households in the study area.

3.5 Sampling Design

The study used multi stage sampling design. In the first stage, all sub locations in the district were classified into two: to be either in peri urban or rural area through a pre survey of the area with the help of chiefs and other government officers. Then two sub-locations were randomly selected from each of the two areas, giving a total of four sub-locations. Then two villages were randomly selected from each sub location. The final stage was simple random sampling from the list of all households in each village to proportionately select the respondents.

3.6 Sampling Frame

A sampling frame is a description of the units of the population from which the sample was drawn. Katulani District has 14 sub-locations, of which 4 are in peri urban while 10 are in a rural setup. Out of the total 9,593 households in the area, 3,465 and 6,128 households are located in peri urban and rural areas respectively; this represents 36% and 64% of the population. The data was obtained from the district registrar of persons. It is on these figures that 40 and 70 questionnaires were proportionately administered to peri urban and rural populations respectively.

3.7 Data Collection

Primary data was collected through observations, photography and using structured questionnaires while secondary data was collected from literature review of existing documentation and unpublished reports from Ministry of Agriculture, Livestock and Fisheries in Katulani District. Each respondent was guided to fill the questionnaire.

3.8 Questionnaire Design

Questionnaires were designed to capture information on farm household demographics, flock structure and dynamics, factors influencing chicken rearing,

adoption of technology and institutional support services and health management on poultry.

3.9 Data Analysis

Data was analysed using Statistical Package for Social Sciences (SPSS) computer software to generate descriptive statistics, Analysis of Variance (ANOVA), chi-square tests and tables.

CHAPTER FOUR: RESULTS AND DISCUSSION

4.1 Introduction

This chapter presents the results and discussion of data collected to achieve the set objectives. The first section characterises the household demographics namely household size, gender of the respondent, age, level of education of the respondents, marital status, employment status and sources of livelihood that influence the perceptions, choices and preferences associated with chicken rearing in the two study sites. The second section describes the flock structure and dynamics of chicken and other livestock in the study area. Flock structure entails number of chicks, pullets, hens, cockerels, cocks and the entire flock size. Similarly, flock dynamics includes type of production system, source of chicks, purpose of keeping chicken and source of initial breeding stock. This is followed by a presentation of respondents' perceptions regarding factors affecting chicken rearing in the study area. The fourth section describes adoption of various technologies, innovations and services that are fundamental for chicken rearing; including factors that influence their adoption and up-scaling. Lastly, section five presents chicken health management practices and strategies in both study sites taking into consideration the indigenous and conventional methods; and factors that influence farmers' choice of different health management strategies.

4.2 Demographic Characteristics of the Respondents

4.2.1 Size of Household

A household size refers to the number of individuals living under one housing unit (Amwata, 2004). In this survey, households were classified into two; small household which refers to households with between $1 \leq 5$ persons and large households for those with more than 5 persons. 0n the other hand, flock sizes were grouped into three classes namely: small flock size for households with less than 10 chicken, medium for those owning between$11 \leq 50$ chicken and lastly large for those households that had more than 50 chicken. The distribution of household size in relation to number of chicken owned is presented in Table 5.

Table 5: Distribution of flock size in relation to household size in rural and peri urban settings

Study site	House hold size	Mean flock size	Flock size		
	Category	(In numbers)	1≤10	11≤50	>50
Rural (n=70)	1 to ≤5	17.64	3(4.3)	11(15.7)	0(0.0)*
	>5	59.73	4(5.7)	26(37.1)	26(37.1)
Peri urban(n=40)	1 to ≤5	20.35	5(12.5)	16(40.0)	5(12.5)
	>5	25.5	2(5.0)	11(27.5)	1(2.5)

**Figures in brackets are percentages*

The rural households had larger household sizes compared to peri urban households Rural households had an average household size of 7 persons. The small households constituted about 20% of the households interviewed while the large households were the majority at 80%. For peri urban areas, the average household size was 5 persons comprising of 65% of small households while the large households constituted 35% large families. In terms of chicken flock size, large households had higher mean flock sizes compared to small households. For example, in rural areas large households had a mean flock size of 59 chicken compared to smaller households who had an average of 17 chicken. A similar scenario was noted in peri urban area, where large households had a mean flock size of 25 chicken while smaller households had 20 chicken. In both sites, large household sizes had the highest number of chicken because they provided adequate labour during chicken management. Besides, each member of the family was expected to own at least a chicken. This finding is similar to those reported by (Nduthu, 2015), where large household size were found to be directly linked to flock sizes. Overall for the study area, there was a significant positive correlation p=0.01, r=0.524 between household size and total chicken flock size. Therefore, household size seems to influence the flock size positively. This implies that the larger the household size, the bigger the flock size. However this may be applicable when environmental and socio economic factors are not limiting.

4.2.2 Gender of the Respondent

Gender refers to the social roles and identities associated with what it means to be a male or female (FAO, 2011). The distribution of household in relation to gender and chicken flock size for the rural and peri urban sites is shown in Table 6.

Table 6: Distribution of flock size in numbers in relation to gender in the study area

Study site	Gender	Mean flock size (in numbers)	Flock size		
			1≤10	11≤50	>50
Rural (n=70)	Male	53.84	2(2.9)	18(25.7)	12(17.1)*
	Female	49.18	5(7.1)	19(27.1)	14(20.0)
Peri urban (n=40)	Male	28.15	2(5.0)	9(22.5)	2(5.0)
	Female	19.26	5(12.5)	18(45.0)	4(10.0)

**Figures in brackets are percentage*

From Table 6, more female headed households were rearing chicken in both study sites. More females (54% in rural and 67.55 in peri urban) kept chicken in the study area because chicken were easily disposable for subsistence purposes. Besides chicken are considered a women venture and men have limited interest due to its low value. Furthermore women who run daily household affairs, chicken can bring quick cash to buy basic household food requirements. This outcome is similar to the findings by Kingori *et al*., (2010) who reviewed the indigenous chicken production in Kenya; Kyule *et al*., (2014) in Nakuru County and Addis and Malede, (2014) in Ethiopia who reported that indigenous chicken rearing is usually associated with women as it is considered a venture of the poor. However even though smaller number of male headed households kept chicken, they kept larger flock sizes than females in both areas. For example, in rural areas males kept a mean flock size of 53 chicken compared to 49 chicken by females. In peri urban areas males kept a mean flock size of 28 chicken compared to 19 chicken by females.

4.2.3 Level of Education and Flock Sizes

Education levels refer to mean years of formal schooling (Amwata, 2004). The respondents level of education were classified into; 1) those with no formal education;

2) primary for those with between 1 to 8 years of formal schooling; 3) secondary for those with between 9 to 12 years and; 4) tertially for those who had attended colleges and universities, with more than 12 year of formal schooling. The distribution of flock size based on education levels is shown in Table 7.

Table 7: Distribution of flock size based on education level in rural and peri urban settings

Study site	Education level	Mean flock size	Flock size		
		(Numbers)	1≤10	11≤50	>50
Rural (n=70)	No formal education	18.40	0(0.0)	5(7.1)	0(0.0)*
	Primary	45.11	5(7.1)	27(38.6)	15(21.4)
	Secondary	84.08	1(1.4)	3(4.3)	9(12.9)
	Tertially	57.40	1(1.4)	2(2.9)	2(2.9)
Peri urban (n=40)	No formal education	11.50	0(0.0)	2(5.0)	0(0.0)
	Primary	22.05	4(10.0)	12(30.0)	3(7.5)
	Secondary	16.46	2(5.0)	10(25.0)	1(2.5)
	Tertially	38.33	1(2.5)	3(7.5)	2(5.0)

**Figures in brackets are percentages*

The average years of schooling in rural areas was 8 years compared to 10 years in peri urban. In rural areas 7.1% had no formal education, 67.1% schooled up to primary level, 18.6% schooled up to secondary level and 7.2% went to tertiary colleges. While in peri urban area 5% had no formal education, 47.5% attended school up to primary, 32.5% schooled up to secondary and 15% up to tertiary levels. The peri urban areas had higher education levels; this was mainly due to better equipped schools, more staff and short distances to school. The national literacy levels stands at 5% with no formal education, 50% with primary education and 46% with secondary education and above (KNBS, 2014). Literacy levels in Kitui County were low due to the high secondary school dropout rates, inadequate education facilities, inadequate staff, low enrolment and low transition rates (GOK, 2014).

In rural areas the mean flock size kept was 18 chicken by those with no formal education, 45 chicken by those with up to primary level of education, 84 chicken by those with secondary level of education and 57 chicken by those with tertially education. This generally shows that the higher the education level the bigger the flock size kept. With high education level, farmers' intellectual capacity is expected to be high. This would in return enhance application of proper chicken rearing practices hence improve household income derived from chicken (Kyule *et al*., 2014).

In peri urban areas the mean flock size kept was 11chicken by those with no formal education, 22 chicken by those up to primary level of education, 16 chicken by those with secondary level of education and 38 chicken by those with tertially education. This also shows that the higher the education level the bigger the flock size kept. Majority in both study sites preferred rearing medium sized flocks.

4.2.4: Marital Status of the Respondents

Marital status was grouped into four, namely; single, married, divorced/separated or widowed. The distribution of flock size based on marital status in rural and urban setting is shown in Table 8.

Table 8: Distribution of flock size based on marital status in rural and peri urban areas

Study site	Marital status	Mean flock size	Flock size		
		(In numbers)	1≤10	11≤50	>50
Rural	Single	68.33	0(0.0)	2(2.9)	1(1.4)*
(n=70)	Married	53.16	5(7.1)	32(45.7)	24(34.3)
	Divorced/ separated	0.00	0(0.0)	0(0.0)	0(0.0)
	Widowed	24.00	2(2.9)	3(4.3)	1(1.4)
Peri	Single	9.50	1(2.5)	2(5.0)	1(2.5)
urban	Married	24.62	3(7.5)	23(57.5)	3(7.5)
(n=40)	Divorced/ separated	5.50	1(2.5)	0(0.0)	1(2.5)
	Widowed	24.60	2(5.0)	2(5.0)	1(2.5)

**Figures in brackets are in percentage*

From Table 8, rural areas had 4.3% household heads who were single, 87.1% married and 7.7% widowed. Peri urban areas had 10% single, 72.5% married, 5% divorced and 12.5% widowed household heads. From the survey, the separated/divorced had the lowest flock size in both rural and peri urban sites. In rural areas, single households were rearing larger flock sizes than married ones. The likely explanation is that single households were mainly rearing chicken to supplement household income, hence kept larger flocks to maximise benefits as opposed to married household heads who reared chicken for subsistence. However, in peri urban areas, majority of the married had larger flock sizes to provide additional source of food for their families. From Table 8, majority of the respondents kept medium size flocks (11≤50). Among married households like in the study area, women are considered to have limited control over decision making on agricultural resource allocation (FAO, 2011; African Development Bank, 2015).

4.2.5 Employment Status

Only 1.4% of rural respondents reported to have been in formal employment compared to 42.5% in peri urban. The unemployment rate was 98.6% in rural areas and 57.5% in peri urban areas. Overall the study area had an unemployment rate of 79.5%; this is compared to 65% unemployment rate for the whole of Kitui County. The high unemployment in Kitui County is attributed to lack of/or limited vocational skills demanded by the economy and the employers (GOK, 2014).

The unemployment rates for the study area and Kitui County as a whole were higher than the national average of 40% (Biko, 2012). However the study showed that the employed in rural areas had larger mean flock sizes of 140 chicken compared to 24 chicken in peri urban areas. This is because the employed have access to capital that enables them to purchase more chicken which was found to be the main method of initial stock acquisition as shown in Table 9.

Table 9: Distribution of flock sizes based on employment status in the study area

Stratum	Employment status	Mean flock size (In numbers)	Flock size		
			1≤10	11≤50	>50
Rural (n=70)	Employed	140	0(0.0)	0(0.0)	1(1.4)*
	Not employed	50.03	7(10.0)	37(52.9)	25(35.7)
Peri urban (n=40)	Employed	24.06	4(10.0)	10(25.0)	3(7.5)
	Not employed	20.74	3(7.5)	17(42.5)	3(7.5)

**Figures in brackets are in percentage*

4.2.6 Livelihood and Income Sources

The respondents' main sources of livelihood were crop farming, livestock production and integrated crop and livestock systems as shown in Table 10.

Table 10: Distribution of respondents by livelihood sources

Livelihood option	Rural (n=70)	Peri urban (n=40)	Overall (n=110)
Livestock	1.40%	2.50%	1.8%
Crop cultivation	20.00%	2.50%	13.6%
Mixed farming	78.60%	95.00%	84.5%

From Table 10, about 84.5% of the respondents earned their livelihoods from mixed farming as compared to crop cultivation (13.6%) and livestock keeping (1.8%). An integrated crop/livestock system was the most preferred because livestock offers security against crop failure and vice versa. Besides, it allows for diversification of livelihoods and efficient utilisation of resources where crops could benefit from animal manure and livestock could benefit from crop residues as source of feed. This finding supports the GOK (2013) that Kitui County had two major livelihood zones; mixed farming livelihood zone and the marginal mixed livelihood zone. The mean monthly incomes from different sources namely, chicken farming, livestock, crops, mixed farming and employment are presented in Table 11.

Table 11: Average monthly incomes for the respondents in Kenyan shillings

Variable	Rural (n=70)	Peri urban (n=40)	Overall (n=110)
Chicken farming	527	600	563.5
Livestock income	1800	3467	3229
Crop income	3762	3000	3550
Mixed income	5077	5275	5129
Employment income	8,500	11,417	11,192
Overall mean income	3933	4752	4733
Chicken contribution to overall mean income	13.4%	12.6%	11.9%

Monthly incomes from mixed farming in the study area were found to be highest (Ksh 5,129) compared to incomes from either livestock farming (Ksh3,229) or crop (Ksh 3,550) farming singly. The few, who had formal employment (16%), had higher monthly incomes (Ksh.11,192) than those relying on agricultural activities. This may be due to the fact that formal employment offered stable and guaranteed income as opposed to farming in an environment characterised by unreliable rainfall and recurrent droughts, often resulting in crop failure and destocking of livestock at low market prices. Employment income had a significant positive correlation $p<0.05$, r=0.643 on how farmers acquired initial poultry flocks, which was mainly through purchase.

Income from chicken farming constituted 13.4% and 12.6% of overall mean household income in rural areas and peri urban sites respectively. In the study area income from chicken farming represented 11.9% of overall mean income. Mean household incomes were Ksh 3,933, Ksh 4,752 and Ksh 4,733 for rural, peri urban and overall respectively. This implied that most of the households had low level of income to meet basic needs and invest in intensive indigenous chicken activities such as construction of chicken house, purchase of good indigenous chicken breeds and even provide good disease/ parasites control. Kitui county income per capita is Ksh 18,240 (GOK, 2013). Poultry contributes 55% to the livestock income, 30% to the

agricultural contribution to GDP and 7.8% of the total Gross Domestic Productin Kenya (Labanthua, 2015; FAO, 2008 and Ochieng *et al*., 2013).

4.3 Flock Structure and Dynamics

4.3.1 Existing Poultry Flock Dynamics

Poultry flock dynamics is one of the factors influencing poultry management. Table 12 summarises the number of farmers rearing poultry, poultry types, use, duration reared, mode of acquisition, breeds, production systems and labour source among poultry farmers in both rural and peri urban areas.

Table 12: Summary of some selected variables

Variable	Choice	Rural (n=70)	Peri urban (n=40)	Overall (n=110)
Type of poultry kept	Chicken only	98.6%	100.0%	99.1%
	Chicken +Ducks	1.4%	0.0%	0.9%
Purpose of keeping poultry				11.8%
	Subsistence	4.3%	25.0%	
	Income	22.9%	2.5%	15.5%
	Subsistence and income	72.9%	72.5%	72.7%
Duration of keeping poultry				11.8%
	≤ 5 years	2.86%	27.5%	
	> 5 years	97.14%	72.5%	88.2%
Method of poultry acquisition				93.6%
	Purchase	95.7%	90.0%	
	Gift	1.4%	10.0%	4.5%
	Inheritance	2.9%	0.0%	1.8%
Breed of poultry	Indigenous	100.0%	100.0%	100.0%
Production system	Free range	100.0%	90.0%	96.4
	Small scale confined	0.0%	10.0%	3.6%
Labour source	Nuclear family	82.9%	82.5%	82.7%
	Extended family	17.1%	17.5%	17.3%

A majority of households (99%) in the study area kept chicken with only 1% of the respondents keeping a combination of chicken, ducks and doves. Chicken are

increasingly becoming a dual enterprise, for subsistence and commercial roles rather than each in isolation. For example, in the study area approximately 72.7% of respondents reared poultry for both income and subsistence while only 11.8% reared for subsistence and 15.5% for income generation. Farmers slaughter them for meat and/or consume their eggs and also sell them in the local poultry markets in small scale to brokers, middlemen or consumers. The income generated is normally used to buy basic household items.

In terms of experience, only 2.86% of respondents in rural areas had reared poultry for less than five years compared to 27.5% in peri urban areas; this indicates that peri urban study site had more new chicken farmers. In the study area, most respondents (96.4%) rear chicken under free range as shown in Figure 2 and 3.

Figure 2

Figure 3

Figure 2 and 3: Indigenous Chicken under Free Range

Almost all the poultry kept in the study area were of indigenous type. The likely explanation was because of the minimal costs involved as chicken scavenge the whole day with limited labour and feed costs. A similar finding has been reported by studies by Danda *et al*., (2010) in the costal lowlands of Kenya; Mailu *et al*., (2012) in Eastern Kenya and Bwalya and Kalinda (2014) in Lusaka, Zambia. From these studies, indigenous chicken were favoured by farmers because they had several advantages namely; resistance to diseases than exotic breeds, cheaper to buy, taste preferences for their meat and eggs in the market, free ranging ability, ability to tolerate harsh climate, easy to dispose/sell and need for less labour. In addition, Bwalya and Kalinda, 2014 indicated that indigenous chicken were favoured since they

cause minimal destruction to the environment and require very little feed supplementation.

The study also found that 82.7% indigenous poultry keeping households utilise nuclear family labour since it is cheap, this agrees with studies done in Machakos County by Nduthu, (2015) who found out that 82% of households were depending on family labour. The main method of initial poultry acquisition was through purchase (93.6%), other methods were 4.5% through gifts and 1.8% through inheritance. This was similar to studies done by Ochieng *et al*., (2013) who found that the main method of initial stock acquisition was through purchase by 74% of farmers in western Kenya. The flocks mainly increased through random breeding and hatching of own chicks. Employment income was found to positively influence purchasing power.

4.3.2 Flock Structure

4.3.2.1 Other Livestock Species Kept

Other livestock species kept by farmers in the study area were goats, cattle, donkey and sheep in decreasing order as shown in Figure 4.

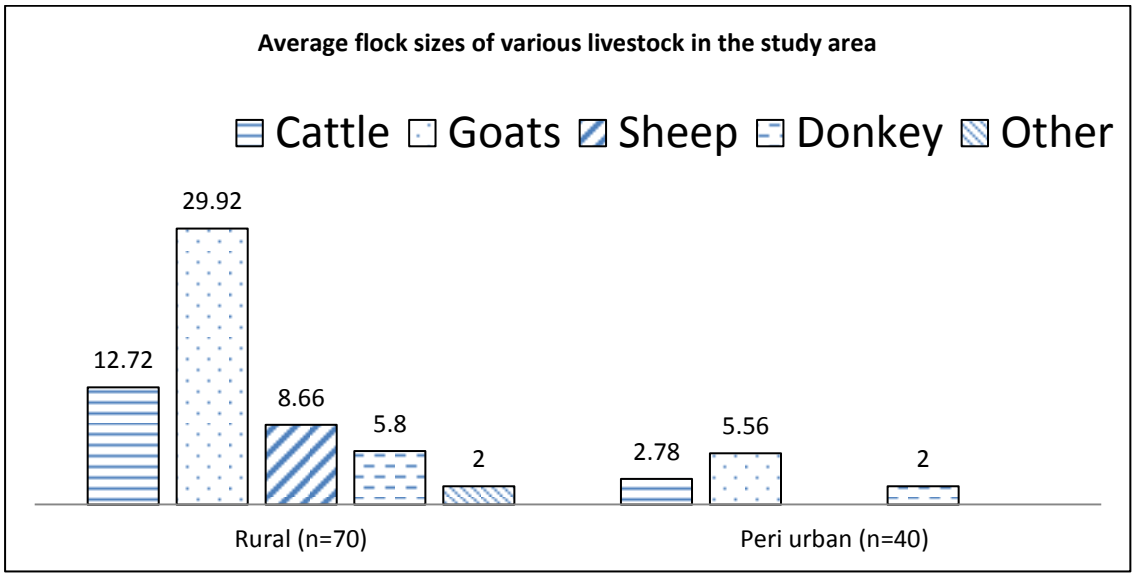

Figure 4: Distribution of livestock in the study area

Chicken and other livestock kept in rural and peri urban areas were converted into Tropical Livestock Units (TLU) and compared to determine the contribution of chicken to overall TLU as shown in Table 13. A Tropical Livestock Unit (TLU) is a

common unit used to describe livestock numbers across species to produce a single figure indicating the total 'amount' of livestock owned (Njuki *et al*., 2011). Chicken were found to contribute 4.18% and 26.88% of total TLU in rural and peri urban areas respectively. The finding that peri urban site had more chicken TLU can be explained by the fact that they had higher adoption rates of poultry management technologies (Refer Table 17) which have been shown to improve productivity (Teklewold *et al*., 2006 and Ochieng *et al*., 2013) in addition to the availability of free ranging land, cheap labour and drinking water in the area.

Table 13: Distribution of livestock in TLU in the study area

Livestock Type	Stratum					
	Rural (n=70)		Peri urban (n=40)		Overall (n=110)	
	Number	Total TLU	Number	Total TLU	Number	Total TLU
Cattle	725	362.5(42.17)	25	12.5(37.92)	750	375(42.02)*
Goats	1855	185.5(21.58)	100	10(30.34)	1955	195.5(21.90)
Sheep	251	25.1(2.92)	-	-	251	25.1(2.81)
Donkey	313	250.4(29.13)	2	1.6(4.85)	315	252(28.23)
Chicken	3592	35.92(4.18)	886	8.86(26.88)	4478	44.78(5.02)
Ducks/ doves	6	0.18(0.00)	-	-	6	0.18(0.00)
Total	-	859.6(100)	-	32.96(100)	-	892.56(100)

**Figures in brackets are in percentage. TLU values used: Cattle 0.5, Goats/sheep 0.1, Donkey 0.8, Chicken 0.01, Ducks/doves 0.03, Pig 0.2, and Camel 1.1 (Njuki et al., 2011).*

Chicken contributed 5.02% of total livestock TLU in the study area. Using the GOK (2009) census results, chicken represented 1.88% of total livestock TLU in Kitui County, while nationally chicken represented 1.74% of total livestock TLU. This shows that chicken contributed at least three times more TLU in the study area than at county and national levels, thus it's a more component of livestock in the study area.

The livestock populations in rural and peri urban areas were tested for any significant variation in herd sizes, the results showed a significant difference ($p<0.05$) in the means of cattle and goat populations between the two sites. Rural respondents were keeping larger herd sizes for both cattle and goats as compared to peri urban group.

Donkeys were used as working animals to carry water, firewood and other small luggage while bulls were mainly used as draught animals during land preparation and planting seasons.

4.3.2.2 Chicken Flocks Composition

The respondents also indicated the composition of their flocks. Chicks, hens and pullets were found to dominate the flock structure as they were mainly retained for production purposes. On average, households kept flock sizes of 40 chicken, although there was a big variation in means between peri urban (22 chicken) and rural areas (51 chicken) mainly attributed to more availability of land and labour in rural areas.

The average flock size of 40 chicken for the study area is higher than that reported by Kingori *et al*., (2010). He established that Kenyan farmers kept an average of 30 indigenous chicken; further Addis and Malede (2014) noted that the average flock size in Ethiopia was 16 chicken while Gueye (1998) reported a flock size of 5-20 chicken in most African villages (Table 14).

Table 14: Chicken flock composition in the study area

Number	Rural (n=70)	Peri urban (n=40)	Overall (n=110)
Number of chicks	14.84±1.9	12.2±1.7	15.42±1.4
Number of pullets	14.19±2.0	1.73±0.8	15.62±2.0
Number of hens	9.31±1.0	5.63±0.5	7.97±0.7
Number of cockerels	8.46±1.2	1.15±0.5	9.97±1.2
Number of cocks	4.59±5.6	1.88±0.5	4.26±0.4
Mean flock size	51.31±0.6	22.15±3.0	40.71±4.0

Chicks, pullets and hens constituted the largest proportion of the total flock size. Chicks constituted the biggest proportion (37.8%). In support Ochieng *et al*., (2013) established that in western Kenya, 80% of the flock structure was dominated by chicks, hens and pullets. Also Addis and Malede (2014) noted that in Ethiopia, flock structure was dominated by chicks and hens. These flock types were mainly retained for production purposes through hatching of own chicks.

The average cock to hen ratio in the study area was 1:2; this slightly differs with the national average as reported by Okeno *et al*., (2010) where the ratio was 1:3. The figures generated in this study fall within the range of other studies from developing countries where the cock to hen ratio was found to be between 1:2.3 -1:6.4 (Mwalosanya *et al*., 2001; Halima *et al*., 2007 and Muchadeyi *et al*., 2007). However, the recommended cock to hen ratio is 1; 10-15 (FAO, 2009). This implies more cocks are kept for breeding than needed thus waste of resources especially on feeding and health management issues. Thus extra cocks should be sold or fattened and sold for meat.

The mean chicken flock size in rural and peri urban areas was tested for significant difference. The results showed significant differences (p<0.05) in the means of pullets, hens, cocks and total flock size between the two sites, where rural respondents had larger flock sizes compared to the peri urban group as shown in Table 15.

Table 15: Distribution of chicken flocks in the study area

Variable	Location	Df	F value	Sig.
Composition of pullets	Between rural and peri urban groups	1	4.571	0.036*
	Within Groups	66		
	Total	67		
Composition of hens	Between rural and peri urban groups	1	5.792	0.018*
	Within Groups	108		
	Total	109		
Composition of cocks	Between rural and peri urban groups	1	5.014	0.028*
	Within Groups	91		
	Total	92		
Total flock size	Between rural and peri urban groups	1	14.144	0.000*
	Within Groups	108		
	Total	109		

** The F statistic is significant at the p<0 .05 level.*

The mean effective flock size per household in the study area was estimated to be 11 chicken, ranging from 12 chicken in rural areas to 6 chicken in peri urban areas. The inbreeding rate per generation was 4.5% in comparison to acceptable levels of 1-2% per generation (Henson, 1992). This means that during scavenging different flocks mix and cocks mate hens from other flocks hence increasing the rate of inbreeding. Farmers therefore need to be encouraged to keep breeding cocks and exchange them with other farmers located further than the scavenging distance. Having many cocks is counterproductive since they spend most of their time fighting for dominance.

Ne is the effective population size per breeding population (study area), Ne was computed as:

$$Ne = \frac{4NmNf}{Nf + Nf}$$

Rural $Ne = \frac{4x4.59x9.31}{4.59+9.31} = 12$ Chickens Peri urban $Ne = \frac{4x1.88x5.63}{1.88+5.63} = 6$ Chickens

Total population $Ne = \frac{4x4.26x7.97}{4.26+7.97} = 11$ Chickens

Where N*m* and N*f* are the average number of breeding cocks and hens per household in the respective populations.

Inbreeding rate (ΔF) was estimated using Wrights equation (Falconer and Mackay, 1996). It was calculated as;

$$F = \frac{1}{(2Ne)} = \frac{1}{(2x11)} = 4.5 \text{ chickens}$$

4.4 Factors Influencing Chicken Rearing in Katulani District

Various factors influencing chicken rearing in the study area and are categorised into opportunities and challenges are shown in table 16

Table 16: Opportunities and challenges of chicken rearing in rural and peri urban areas

	Rural (n=70)		Peri urban (n=40)	
Variable	**Opportunity %**	**Challenge %**	**Opportunity %**	**Challenge %**
Feed	47.2	52.8	65	35
Disease		100	2.5	97.5
Theft	14.3	85.7	20	80
Skills	1.4	98.6	72.5	27.5
Vet/extension skills	2.8	97.1	62.5	37.5
Inputs	12.9	87.2	57.5	42.5
Technology availability	8.6	91.5	67.5	32.5
Credit availability	22.9	77.1	60	40
Quality breed availability	15.7	84.3	37.5	62.5
Predators	11.4	88.6	2.5	97.5
Climate effects	52.9	47.1	20	80
Markets	50	50	62.5	37.5
Selling prices	60	40	75	25
Water availability	95.7	4.3	92.5	7.5
Labour availability	97.1	2.8	92.5	7.5
Drugs/vaccine costs	1.4	98.6	20	80
Land/space availability	91.4	8.5	85	15

There are several opportunities and challenges faced by farmers during chicken rearing in the study area. The challenges include feed, diseases, theft, limited skills,

limited veterinary extension and in adequate inputs. Also limited access to technology and credit facilities were among the factors critical for chicken rearing.

Chicken diseases were a major setback to chicken rearing in the study area. They constituted 100% and 97.5% challenge in rural and peri urban sites respectively. These findings are similar to those of Kyule *et al*., (2014) and Ochieng *et al*., (2013) who reported that diseases were the major cause of chicken deaths and it discourages farmers from keeping large flocks of chicken for fear of losing them during disease incidences. The main opportunities listed in rural areas were availability of labour (97.1%), availability of land (91.4%) and availability of water (95.7%). Major challenges listed were diseases incidences by all respondents especially NCD and coccidiosis, limited expertise in chicken production (98.6%), and high cost of drugs/vaccines (98.6%). In peri urban areas the main opportunities listed were availability of labour (92.5%), availability of water (92.5%) and availability of land (85%). While main challenges listed were predation (97.5%), diseases (97.5%), theft and high cost of drugs and or vaccines (80%).

Unavailability of chicken rearing technologies usually prevents farmers from overcoming traditional chicken farming behaviours thereby unable to increase income and reduce poverty (Epiphane and Arne, 2012). The authors also suggested that farmers should be initially advised to adopt low cost technologies like chicken house construction using local materials, vaccinations and feed supplementation in that order as the three have shown to enhance the survival rate of chicken.
Limited access to veterinary, extension services and chicken production skills in the study area is common in most extensive chicken production systems, chicken productivity usually increases when proper and timely veterinary and extension services are provided to farmers (Ochieng *et al*., 2013).

Unavailability of superior chicken breeds was reported in both sites; by 84.3% and 62.5% of respondents in rural and peri urban areas respectively. Okeno *et al*., (2010) indicates that the improved breeds possess characteristics such as bigger body size, improved growth rate and egg yield, better mothering ability, disease tolerance and

improved fertility. These are traits of economic importance and in any breeding program it is recommended to consider current and future production circumstances.

4.5 Technology and Support Services Adoption

4.5.1 Farmers' Adoption of Different Chicken Management Practices

The respondents listed the different chicken management practices carried out in the households, which included vaccinations, predator and rodent control, feed supplementation, housing, brooding, hatching and use of improved chicks or improved cockerels. The use of each technology was categorised as; regularly or rarely as shown in Table 17.

In overall, the results showed low adoption of all chicken management technologies in the study area especially in rural areas. This indicates a low input-low output production system which is characteristic of free range system (Bwalya and Kalinda, 2014; Ochieng *et al*., 2013). There were higher adoption rates of all technologies in peri urban areas than rural areas. In rural areas the regularly used technologies were predator and rodent control (47.2%), vaccination (18.5%), housing (11.4%), brooding and hatching (10%), with feed supplementation and improved chick rearing having the least at 1.4%. In peri urban areas, the regularly used technologies were vaccination (87.5%), feed supplementation (80%), predator and rodent control (72.5%) and brooding (55%) in that descending order. The least adopted technology in the study area was improved chick rearing by 2.7% of respondents, while the best adopted technology was predator and rodent control by 56.4% of respondents. On the same note only 20.9% of respondents regularly house their chicken.

Table 17: Adoption rates of various poultry management technologies

Variable	Rate	Adoption rates in percentages		
		Rural (n=70)	Peri urban (n=40)	Overall (n=110)
Vaccination practice	Regularly	18.5	87.5	43.6
	Rarely	81.5	12.5	56.4
Predator/rodent control practices	Regularly	47.2	72.5	56.4
	Rarely	52.8	27.5	43.6
Feed supplementation practices	Regularly	1.4	80	30
	Rarely	98.6	20	70
Housing practices	Regularly	11.4	37.5	20.9
	Rarely	88.6	62.5	79.1
Brood/hatch practices	Regularly	10	55	26.3
	Rarely	90	45	73.7
Improved chick rearing	Regularly	1.4	5	2.7
	Rarely	98.4	95	97.3
Adoption of whole package	Yes	0	0	0

For those who housed the chicken, most of the houses were built using locally available materials and designed to protect chicken from rodents and predators especially at night as shown in Figures 5 and 6.

Figure 5

Figure 6

Figure 5 and 6: Above ground chicken houses as an innovative way used by farmers to protect chicken. The ladder is removed once the chickens are inside to prevent rodents and predators from accessing the house at night.

Only 30% of respondents regularly provided feed supplements to the chicken in the study area. Feed supplementation was lowest in rural areas while 80% of peri urban respondents regularly provided feed supplementation to their flock as compared to 1.4% in rural areas. Most of the supplements were cereal grains thrown on the ground for chicken to feed on as they free range within the compound as shown in Figures 7 and 8.

Figure 7

Figure 8

Figures 7 and 8: Example of supplementation mainly practiced in the study area using left over's and mostly thrown on the ground.

Brooding and hatching was regularly practiced by only 10% and 55% in rural and peri urban areas respectively, while rearing of improved chicks was regularly practised by 2.7% of respondents in the study area. There was no farmer who adopted the package as a whole. Hatching is important in rural settings since it is more economical in time and money than artificial incubators, as broody hens only need to be given a safe, clean shelter, adequate feed and clean water to hatch. In addition, brooding is important as it allows chicks to feed without competition from other chicken and stay safe from predators; thus, faster growing chicks, fewer expenses on feeds and more surviving chicks (Farzin and Ineke, 2011).

4.5.2 Access to Extension Support Services

The respondents also acknowledged accessing the various institutional support services such as extension, veterinary health care, credit facilities, chicken rearing trainings, markets and market information. Access to extension support services was

classified into yes or no. There was generally poor accessibility to extension services in the study area.

When accessibility to these services were tested for any variation, rural areas were found to have higher access to extension services compared to peri urban areas with a significant difference (p=<0.05). This is mainly because rural areas had higher demand for extension services to increase survivability of their large flock size.

4.5.3 Sources of Chicken Rearing Support Services

The main chicken rearing support service providers include non-government organisation (NGO), government, community based organisations and microfinance banks (Table 18).

Table 18: Sources of support services

Variable	Level	Rural % (n=70)	Peri urban % (n-40)
Extension services	NGO	1.4	0
providers	Government	42.9	2.5
	None	55.7	97.5
Credit sources	Formal	1.4	0
	Informal	7.1	10
	None	91.4	90
Membership to a poultry group	Yes	0	2.5
	No	98.60	95.00
	Sometimes	1.40	2.50

Government staff offered 42.9% and 2.5% of all poultry production extension services in rural and peri urban areas respectively. NGO were only accessible in rural areas to 1.4% of respondents. The rest of the farmers could not access these services; this indicates poor accessibility of extension services in the study area.

Credit facilities for rearing chicken were mostly accessed from the informal market by 7.1% and 10% of respondents in rural and peri urban areas respectively. Credit from formal markets i.e. microfinance institutions like banks, savings and credit

cooperatives and Agricultural Finance Corporation was only accessed by 1.4% of respondents in rural areas.

There was also poor membership to chicken rearing groups; this is similar to a finding by Ayieko *et al*., (2014) in Makueni County. Group membership has been shown to have benefits like easier access to trainings, collective purchasing of inputs so as to reduce costs because of economies of scale, easy access to credit services since they could guarantee each other, collective marketing with the aim of reducing transaction costs and bargaining power (Ayieko *et al*., 2014; Kinambuga, 2010 and Danda *et al*., 2010).

4.5.4 Factors Influencing the Current Adoption of Various Management Technologies, Innovations and Institutional Support Services in the Study Area.

Respondents were asked to indicate factors that influence their adoption of various chicken rearing technologies and access to institutional support services. Adoption of chicken management technologies has been shown to move indigenous chicken production from more subsistence to income generation in rural households (Epiphane and Arne, 2012). The factors are shown in Figure 9.

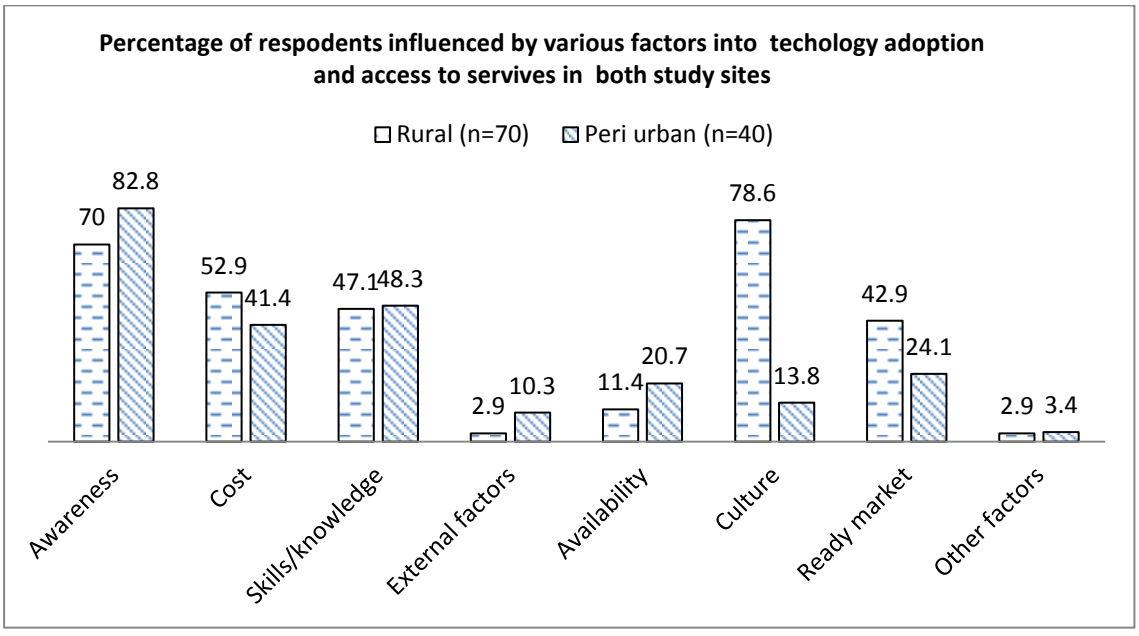

Figure 9: Factors influencing adoption of chicken rearing technologies and access to institutional support services.

In rural areas the main factors considered by farmers before adopting a technology or seeking support services were culture (78.6%), awareness of expected benefits (70%), cost of the technology/service (52.9%), farmer's knowledge on the application of the technology (47.1%) and availability of ready market (42.9%) while in peri urban areas the main factors considered were awareness of expected benefits (82.8%), farmer's knowledge on the application of the technology (48.3%) and cost (41.4%).

The pricing mechanism was on bargain basis for a willing buyer and seller. Chicken markets among free range farmers were mainly dominated by middlemen who mainly used hand weighing to estimate weights thereby exploiting farmers; this has a potential to influence farmers into maintaining low input production systems instead of adopting modern chicken production technologies and extension support services (FAO, 2009; Danda *et al*., 2010).

4.6 Health Management

4.6.1 Disease Occurrence and Management

Respondents were asked to indicate if they had experienced diseases in their chicken flocks, whether they had used any intervention to manage the diseases and the type of medication used as shown in Table 19.

Table 19: Disease occurrence and management in the study area

Variable	Options	Rural (n=70)	Peri urban (n=40)	Sig. Values
Disease occurrence in chicken				0.000*
	Yes	100.00%	52.50%	
	No	0.00%	47.50%	
Medication use in chicken				0.038*
	Yes	98.60%	90.00%	
	No	1.40%	10.00%	
Medication type	Traditional	80.00%	20.00%	0.000*
	Conventional	10.00%	57.50%	
	Traditional and conventional	10.00%	22.50%	

** The Chi-square statistic is significant at the p<0.05 level.*

Diseases were reported by all respondents in rural areas, as opposed to 52.5% in peri urban areas. It was concluded that Newcastle disease and coccidiosis were the common diseases since majority of farmers reported sudden deaths associated with greenish or bloody diarrhoea which are characteristic of the two diseases. This finding is similar to that of Mutombo (2015) who documented that in Machakos County, coccidiosis and Newcastle are the commonest diseases. The respondents indicated sneezing, nasal discharges, eye infections, inability to feed, general weakness, bloody and greenish diarrhoea, dropping feathers, sudden deaths and slow movements as ways of knowing when their chicken were sick.

Medicines to manage chicken diseases were applied by 98.6% and 90% of respondents in rural and peri urban areas respectively. Traditional medicinal products were the most common method of disease management in the rural areas where 80% of respondents used them; this is similar to findings by Mutombo (2015) in Machakos County where about 87% of chicken farmers were reported to use traditional medicine to treat diseases due to limited access to cash. Conventional medicines were mostly used in peri urban areas where 58% of respondents preferred their use. This is mainly due to their proximity to town centres and access to cash. The results showed significant differences ($p<0.05$) between the two study sites on disease occurrence, medication use and type of medicinal product used. Rural areas had more disease incidences, used more medication on their chicken and preferred use of traditional medicinal products (Table 19).

From the survey, the medicinal products used for health management on chicken can be classified into three categories; biological, chemical and conventional. Chemical products used were sugar, charcoal powder, battery cell powder and soot. The biological products used were Aloe vera, red bitter belly, Maerua decumbens roots, Africa night shade, neem tree, marabou thorn leaves, euphorbia, mush room, cough grass, wandering jew, Vernonia lasiopus, pepper, goat milk, Melia volkensii guerke, onions and wild lettuce. Lastly, the conventional medicines bought from agrovets and the common products were egocin and metrocycline. Aloe vera, neem tree, pepper and goat milk were the most common medicinal products used by respondents.

The use of medicinal products in rural areas were as follows; Aloe vera (42.86%), neem tree (38.57%), pepper (25.71%), goat milk (14.29%), Vernonia lasiopus (11.43%) and Mellia volkensii guerke (10%). Other products used in rural areas were African night shade, tobacco powder, sugar, marabou thorn leaves, charcoal powder, euphorbia, mushroom, cough grass, wandering jew, soot, battery cell powder and onions (Table 20).

On the other hand only four medicinal products were used in peri urban area as follows; Aloe vera (32.5%), pepper (15%), red bitter belly (7.5%) and Maerua decumbens roots (2.5%).

Table 20: Traditional practices in chicken health management

Local name	English/scientific name	Preparation and administration	Diseases treated
Battery cell powder	Battery cell powder	Powder in drinking water	Diarrhoea
Muvatha	Vernonia lasiopus	Smashed leaves in drinking water	Newcastle disease
Kiluma	Aloe species/Burn plant	Juice mixed in water or slice leaves put into drinking water	Newcastle and other diseases
Muteta	Red bitter berry/ strychnos henningsii	Roots and bark in boiled drinking water	Various diseases
Goat milk	Goat milk	Milk administered orally	Diarrhoea
Onions	Allium species/ Onions	Slices in drinking water	All diseases
Tobacco powder	Nicotinia tubacum/ Tobacco powder	Powder	Drowsiness
Kitulu /manage	African night shade/Sollanum villosum	Leaves fed to poultry	Diarrhoea
Mwarobaini	Azandirachta indica/ Neem tree	Smashed leaves and bark in drinking water	Newcastle disease Worms, coccidiosis Fowl typhoid and cholera
Ndulu and kiluma	Pepper, euphorbia and aloe species	Chopped pepper mixed with aloe juice and euphorbia in drinking water	Newcastle and Fowl typhoid
Mukau tree	Melia volkensii guerke	Smashed bark and leaves in drinking water	Worms, Newcastle disease, coccidiosis

Uthunga	Launaea cornuta/ wild lettuce	Chopped in drinking water	Various diseases
Muwae	Soot	In drinking water. Usually mixed with pepper	Newcastle disease and other diseases
Kinatha roots	Maerua decumbens	Roots soaked in drinking water	Various diseases
Charcoal powder	Charcoal powder	In drinking water	Diarrhoea and poisonings
Ndulu and ikunu	Pepper and mushroom	Crushed and mixed in drinking water	Improving immunity/quick recovery in all diseases Respiratory disturbances
Cough grass and Ndulu	Elymus repens Cough grass/quack grass	Mixed in drinking water	Newcastle disease and fowl typhoid
Sukali	Sugar	Solution in drinking water	Weakness
Muselesele leaves	Sickle bush, Marabou thorn	Smashed leaves in drinking water	Anthelmintics and stomach problems
Wandering jew juice	Wandering jew plant	Leaves smashed in drinking water	Fowl typhoid and coccidiosis

Medicinal plants were used more than other types of traditional products, the main plant parts used were roots, seeds and leaves. The method of preparation involved giving some parts of the plant like leaves alone or a combination of parts of the same plant like roots and bark. Combination of parts of different plants was also widely practiced. Routes of administration were mainly orally where plant parts were mixed in drinking water.

The most widely used medicinal plant was Aloe vera; it was used to manage several diseases including Newcastle disease. Their leaves were harvested, cleaned with water, and crushed or sliced into pieces before mixing with drinking water. The medicated water was offered to sick chicken until they showed signs of good health. Aloe vera has been documented to have several pharmacological properties: it is antibacterial, antifungal, antivenin, immunological properties, anti-allergy and anti-inflammatory properties. It is a perennial herb that originates in the tropics and therefore is readily available, accessible and inexpensive (Marizvikuru *et al*., 2005). It has a wide usage even by many other communities in Kenya (Shivairo *et al*., 2013

and Ndegwa *et al*., 2014). Some chicken farmers in the study area used it for prophylactic purposes by mixing it in drinking water and strategically placing it in the compound so that chicken can drink it while on free range.

Another commonly used medicinal plant was neem tree (Azandirachta indica); commonly known as mwarobaini in Kenya. Its leaves and bark are smashed and mixed with water to treat various conditions. Gueye (1999) and Ndegwa *et al*., (2014) found that it had been used to treat various endoparasites in many African villages. Pepper (capsicum species) was used to manage several diseases. Onions (Allium species) chopped and soaked in drinking water has been used to treat fever (Gueye, 1999). Melia volkensii guerke, locally known as Mukau tree has also been reported to increase appetite when given in boiled drinking water while Vernonia lasiopus locally known as Muvatha has been administered in drinking water to treat digestive disturbances (Kwesi and Philip, 2004). Battery cell powder was used by farmers in the study area to treat diarrhoea. Strychnos henningsii locally known as Muteta was also widely used; it has been reported to treat various diseases when the bark, roots and fruits were administered in boiled drinking water (Kuria *et al*., 2012). Soot and pepper have been used to treat coccidiosis (Marizvikuru *et al*., 2005).

Charcoal powder and sugar were administered as solutions in water. Figure 10 shows how one of the respondents administered medicated drinking water.

Figure 10: Receptacle placed within the compound to administer drinking water to free range chickens in Mavindini village, Kitui County.

The container in Figure 10 was anchored to the ground at one point in the compound so that chicken could access it throughout the day. Medication could be added to the water for treatment or prophylactic purposes. Farmers discontinued administering the medication once signs of good health were observed. No adverse effects were reported during administration

4.6.2 Factors Influencing Farmers' Choice of Health Management Strategies

There are several factors that influence the choice of health management strategies among farmers. They include costs, availability, accessibility, religion, culture and ease of administration (Table 21).

Table 21: Factors influencing choice of medication

	Location		Overall (%)
	Rural (%)	Peri urban (%)	
Factors	**(n=70)**	**(n=40)**	**(n=110)**
Cost	59.4	25.0	47.6
Availability	91.3	36.1	72.4
Accessibility	56.5	22.2	44.8
Healing ability	89.9	94.4	91.4
Ease of administration	44.9	19.4	36.2
Risk of overdose	2.9	16.7	7.6
Indigenous knowledge	34.8	16.7	28.6
Religion	1.4	2.8	1.9
Culture	71.0	5.6	48.6

Respondents were asked to indicate factors that influenced their choice of using traditional or conventional medicinal products. Over 90% and 94% of the respondents in rural and peri urban areas respectively would chose a strategy that has the ability to heal a certain disease until signs of recovery were observed. There was a significant difference at $p<0.05$ on local availability of a medicinal product with 91% of rural respondents listing it as a key factor to consider compared to 36% of peri urban

respondents. This difference explains why 80% rural respondents favoured traditional health management methods, since they are far from agro vet shops and had limited resources to buy the drugs; whereas 58% of peri urban respondents preferred the use of conventional medicines due to their proximity to the agro vets. There was a significant difference at $p<0.05$ on influence of culture on the health management methods between rural and peri urban respondents. About 71% of rural respondents indicated that culture was critical as compared to 5.6% of peri urban respondents. Overall, 48.6% of the respondents ranked it as the third main factor influencing their choice of medicinal product for the chicken.

Other factors that were found to influence the choice of chicken health management methods were cost of drugs (47.6%), accessibility (44.8%), ease of administration (36%), indigenous knowledge (29%), risk of overdose (8%) and religious affiliation (2%). Respondents were also asked to suggest on how they can be supported to enable them realize maximum benefit from chicken production (Table 22).

Table 22: Chicken farmers support needs

Variable	**Rural n=70**	**Peri urban n=40**	**Overall n=110**
Trainings and seminars	32(45.7)	23 (57.5)	55 (50)*
Input provision	15(21.4)	19 (47.5)	34 (30.9)
Markets and market information	5(7.1)	7 (17.5)	12 (10.9)
Improves indigenous breeds or exotic breeds	3(4.3)	8 (20)	11 (10)
Credit	8(11.4)	1 (2.5)	9 (8.3)
Technical staff	6(8.6)	2 (5)	8 (7.3)
Grants	3(4.3)	1 (2.5)	4 (3.6)
Vaccinations	2(2.9)	0 (0)	2 (1.8)

**Figures in brackets are in percentage*

About 50% of respondents requested for more training and seminars on general chicken rearing especially on disease control and housing design. They suggested the trainings be conducted by qualified experts from county and national governments

and Non-Governmental organisations. However, 30.9% of respondents requested for provision of inputs, specifically chicken feeds, feed supplements, drugs/vaccines and construction of chicken houses. About 10.9% suggested provision of regular market information to ensure they get maximum benefits from their chicken rather than being exploited by middlemen. About 10% requested the provision of improved indigenous and exotic breeds, 8.3% for provision of credit, 7.3% for additional extension and veterinary staff, 3.6% for provision of grants and 1.8% for regular vaccinations campaigns by veterinary department.

CHAPTER 5: CONCLUSION, RECOMMENDATIONS AND FUTURE RESEARCH AREAS

5.1 Conclusions

- Household demographics (house hold size, education, gender, employment status) had influence on flock size kept
- The production system in the area was low input
- There was an opportunity for small start-up and low capital investment
- Main challenges included diseases, theft, predators, harsh weather and high cost of drugs/vaccines
- Chicken were a key livestock component although kept under poor husbandry
- Ethno veterinary medicines were widely used in the area, especially aloevera, neem tree, goat milk and pepper
- Healing ability, availability and cost of any drug were main factors guiding choice of drug used
- The area had poor access to extension services
- Farmers needed more trainings and subsidized services
- Benefits of using any technology, affordability, knowledge and skills about application of any technology were the main factors considered by farmers when using any management technologies like vaccination, feed supplementation, housing, brooding and hatching.

5.2 Recommendations

- Initiatives that support women in chicken production should be prioritized since they form the majority of chicken farmers
- Enhance education and awareness as it is critical for uptake of chicken technologies and innovations in chicken farming
- Reduce number of cocks and start cock exchange programs to reduce inbreeding and wastage of feed resources
- Initiate awareness creation on benefits of various management technologies, cost-benefit analysis and impact skills on their application to increase their uptake

- Initiate trainings on disease control and put in place a regular disease control programme
- Provide regular support services to farmers especially extension services, market information including price trends
- Encourage chicken farmers to form farmer groups for ease of accessing various services and enhanced bargaining power.
- Train Village Based Advisors/Agents (VBAs)
- Facilitate farmer field schools to share indigenous knowledge on use of traditional medicinal products

5.3 Future Research Areas

More research needs to be conducted on chemical composition, efficacy, dosage and side effects of key traditional medicinal products used in the study area. They can act as a substitute for conventional drugs or in combinations.

More field observations on use of traditional medicines on chicken health management should be documented in order to highlight chicken healthcare needs among the chicken farmers.

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APPENDICES

APPENDIX 1: INTRODUCTORY LETTER

Dr Royford Murangiri
Po box 289
Kitui
0724320204

Dear Sir/Madam

RE: REQUEST TO FILL QUESTIONNARES FOR RESEARCH PURPOSE

I am a post graduate student at South Eastern Kenya University, department of Range and wildlife sciences and I am carrying out a research on challenges affecting chicken farmers in Katulani District-Kitui County

The information gathered will be treated as confidential and will be for the sole purpose of this study. Kindly respond to the items in the attached questionnaires to the best of your knowledge

Thank you

Dr Royford Murangiri

APPENDIX 2: QUESTIONNAIRE

QUESTIONNAIRE NO…… Date.....

SECTION A: GENERAL INFORMATION

Location_____Village_____

Contact information: _____

1. Size of the household _____

2. Gender of the respondent (a) Male ( ) (b) Female ( )

3. Age of the respondent: 0-5 years----------5-14 years……+15 years……..

4. Level of education of the respondent (state formal years of schooling in numbers)…….

5. Marital Status

a. Single ( ) b. Married ( ) c. Divorced/separated ( ) d. Widowed ( )

6. Employment status a. Employed ( ) b. Not employed ( )

7 i) What is your main source of livelihood?

a) Livestock b) crop cultivation c) mixed farming d) Others (specify)……

ii) What would be your monthly income estimate from the above mentioned livelihood sources

Livestock ……Kshs/month

Crop cultivation……..Kshs/month

Mixed farming ……Kshs/month

Employment…….Kshs/month

Others (specify)……..Kshs/month

SECTION B: FLOCK STRUCTURE AND DYNAMICS

8 i) Does your household keep poultry? a) Yes b) No……

ii) Which type of poultry does your household keep? (List and the numbers)

……
……

9. What is your purpose of keeping the above type (s) of poultry?

a) Subsistence/food b) Source of income c) both a and b d) Others (specify)

10. What other livestock species do you keep? (State numbers of each livestock species)

a. Cattle ( ) b. Goats ( ) c. Sheep ( ) d. Donkeys ( ) c. Other (specify)

11. How long have you kept poultry?

a. less than 1 year ( ) b. 1-5 years ( ) c. over 5 years ( )

12. How did you acquire your initial poultry stock?

a) Direct purchase ( ) b. Loan ( ) c. Gift ( ) d. Inheritance ( )

13. What breeds of poultry do you keep?

a. Indigenous/local chicken ( ) b .Exotic/commercial chickens ( ) c. both ( )

14. What is the composition of your flock? (Indicate the number for each category)

a. Chicks ( ) b. Pullets ( ) c .Hens ( ) d .Cockerels ( ) e. Cocks ( ) e .Flock size ( )

15. i) What kind of poultry production system do you practice?

a. Free range ( ) b.Small scale confined ( ) c.Large scale

ii) Why have you chosen that particular type of the poultry system? (Emphasize on advantages and disadvantages)

……

……
……

.....
.....

16. What is the source of labour for your poultry production system?

a. Nuclear family ( ) b. Extended family ( ) c. Hired ( ) d. Others (specify) ( )

SECTION C: FACTORS INFLUENCING CHICKEN REARING

17. Indicate how the following factors influence chicken rearing in your farm? Rank the factors whether an opportunity, major, minor or not a challenge.

	Factors	**Opportunity**	**Major challenge**	**Minor challenge**	**Not a challenge**
A	Feeds availability and feed costs				
B	Diseases and parasites				
C	Theft/insecurity				
D	Availability of production poultry skills				
E	Availability of veterinary/extension services				
F	Costs of initial inputs-eg housing				
G	Availability of poultry rearing technologies				
H	Access to credit				
I	Availability of quality chicken breeds				
J	Predators				
K	Climate effects				
L	Marketing and availability of markets				
M	Selling prices for chicken/eggs				
N	Water availability				

O	Labour availability				
P	Cost of drug and vaccination				
Q	Availability of land/space				
R	Others				

SECTION D: TECHNOLOGY AND SERVICES ADOPTION

18 a) Do you normally carry out any poultry handling and management practices? List them in order of priority.

i)

ii

iii

iv

v. etc

19 b) How frequently do you carry out the following poultry management practices?

Practice	Regularly	Occasionally	Rarely	Never
Vaccinations				
Predator/rodent control				
Feed supplementation				
Housing				
Brooding/hatching				
Rearing improved chicks (possess improved cockerels)				
Adoption of whole package above	A. Yes ( ) B. No ( )			

20. Do you have access to the following services?

Type of Service	Yes	No	Sometimes	Remarks
Access to extension services				
If yes above who is the main extension service provider and how regularly a)NGO b)Government				
Access to veterinary services				
Access to credit				
If yes above what is the source of credit a)Formal b)Informal				
Access to chicken rearing trainings				
Are you a member of any poultry related group				
Access to market/marketing information				

21.Which of the following factors influenced your use of above technologies and support services? (Tick only the ones applicable to you)

	Factor	Tick
1	Awareness of their benefits	
2	Cost of adoption/affordability	
3	Technical Skills and/or knowledge of owner/staff	
4	External factors e.g. government policies, infrastructure,	
5	Availability of the technology and services	

6	Culture	
7	Ready market for the products	
8	Others (Specify)	

SECTION D: HEALTH MANAGEMENT

22 i) Have your poultry suffered from any disease(s)? a) Yes ( ) b) No ( )

ii) If Yes, how did you diagnosis the disease?

.....……
……

23 i) Have you ever used medication to treat any of the poultry diseases in your farm?

a. Yes ( ) b. No ( )

ii) If Yes what medications are commonly/frequently used?

Decision	Tick	Remarks
Natural/traditional/herbal products		
Drugs bought from agrovets/modern drugs		
Both traditional and modern drugs		
Other(please state)		

24. If you have used any natural/traditional products, please list them below and the health issues they address.

a) ……

b) …….

c) …….

d)…….

25. Which of the listed factors below influenced your choice of medication above? (Tick where applicable)

Factor	
Cost	
Local availability	
Accessibility	
Its healing ability	
Ease of administration	
Risk of overdose	
Local indigenous knowledge	
Religion	
Culture	

26. Do you have any suggestions on how you can be supported to enable realize maximum benefit from poultry production? (State the suggestion and who/ the institution to address it

……
……
……
……
……

Thank you for taking your time.