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HPAI PRO-POOR HPAI RISK REDUCTION

An Overview of the Poultry Sector and Status of Highly Pathogenic Avian Influenza (HPAI) in Kenya —Background Paper

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Preface

Since its re-emergence, HPAI H5N1 has attracted considerable public and media attention because the viruses involved have been shown to be capable of producing fatal disease in humans. While there is fear that the virus may mutate into a strain capable of sustained human-to-human transmission, the greatest impact to date has been on the highly diverse poultry industries in affected countries. In response to this, HPAI control measures have so far focused on implementing prevention and eradication measures in poultry populations, with more than 175 million birds culled in Southeast Asia alone.

Until now, significantly less emphasis has been placed on assessing the efficacy of risk reduction measures, including their effects on the livelihoods of smallholder farmers and their families. In order to improve local and global capacity for evidence-based decision making on the control of HPAI (and other diseases with epidemic potential), which inevitably has major social and economic impacts, the UK Department for International Development (DFID) has agreed to fund a collaborative, multidisciplinary HPAI research project for Southeast Asia and Africa.

The specific purpose of the project is to aid decision makers in developing evidence-based, pro-poor HPAI control measures at national and international levels. These control measures should not only be cost-effective and efficient in reducing disease risk, but also protect and enhance livelihoods, particularly those of smallholder producers in developing countries, who are and will remain the majority of livestock producers in these countries for some time to come.

This report is the first step of the project which has compiled and assessed the current state of knowledge of poultry systems and their place in the larger economy of the study country, the current HPAI situation and its evolution, and institutional experiences with its control (or, where it has not taken place, contingency places should it arise). This information has been written by a multidisciplinary national team in the study country highlighting the current knowledge and knowledge gaps related to the interface of poultry, HPAI, and institutional response as a crucial first step to the analytical research outputs to be generated in the course of this project. In the process of writing the background paper a variety of country-specific data and information sources on poultry systems, HPAI, and mitigation/control efforts, including published and grey literature, national statistics, journal articles, and reports from other research efforts that are ongoing in the country have been complied into a data base located at the project web site http://www.hpai-research.net/index.html.

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Disclaimer

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More information

For more information about the project please refer to www.hpai-research.net.

Acronyms and Abbreviations

AGID	Agar Gel Immuno Diffusion
AHSP	Animal Health Service Providers
AI	Avian Influenza
ASALs	Arid and Semi Arid Lands
AU-IBAR	African Union – InterAfrica Bureau on Animal Resources
BSE	Bovine Spongiform Encelopathy
CAHWs	Community based Animal Health Workers
CDC	Centre for Disease Control and Prevention
CIA	Central Intelligence Agency
CVFO	Chief Veterinary Field Officer
CVIO	Chief Veterinary Investigation Officer
CVL	Central Veterinary Laboratory
DANIDA	Danish International Development Agency
DOC	Day Old Chicks
DRC	Democratic Republic of Congo
DVO	District Veterinary Officer
DVS	Department of Veterinary Services
ELISA	Enzyme Linked Immunosorbent Assay
EPZ	Export Processing Zone
EPZA	Export Processing Zone Authority
ESS	Epidemio-Surveillance System
FAO	Food and Agriculture Organisation of the United Nations
GDP	Gross Domestic Product
GIS	Geographical Information systems
GoK	Government of Kenya
GPS	Grand Parent Stock
HDI	Human Development Index
HE	Hatched Eggs
HPAI	Highly Pathogenic Avian Influenza
IBD	Infectious Bursal Disease
ILRI	International Livestock Research Institute
ITK	Indigenous Technical Knowledge
JKIA	Jomo Kenyatta International Airport
KALT	Kenya Association of Livestock Technicians
KELITA	Kenya Livestock Technicians Association
KEPHIS	Kenya Plant Health Inspectorate Service
Kg	Kilogram
Km	Kilometre
Ksh.	Kenya shilling; 1US dollar = Ksh 64 (July 2008)
KVB	Kenya Veterinary Board
KWS	Kenya Wildlife Services
LHA	Livestock Health Assistant
LHA	Livestock Health Assistant
LO	Livestock Officer
M	Metre
MoLFD	Ministry of Livestock and Fisheries Development
NAI	Notifiable Avian Influenza
ND	Newcastle disease
NMK	National Museums of Kenya
NOC	National Office Disaster Management Committee
OIE	World Organisation for Animal Health
PACE	Pan African Programme for the Control of Epizootics

PCR	Polymerace Chain Reaction
PDVS	Provincial Director of Veterinary Services
PS	Parent Stock
RAT	Rapid Antigen Test
RVIL	Regional Veterinary Investigation Laboratory
SARS	Severe Acute Respiratory Syndrome
UNDP	United Nations Development Programme
UNICEF	United Nations Children Fund
USAID	United States Aid Development Agency
VEEU	Veterinary Epidemiology and Economics Unit, Kabete
WHO	World Health Organisation

Executive Summary

Poultry keeping in Kenya plays a major role as a livelihood source, an income generating activity as well meeting other socio-cultural roles. Poultry production is, however, threatened by the emerging HPAI threat that has devastated other parts of the world. This study documented available information on the poultry sector. The objective was to identify knowledge gaps that HPAI research in Kenya should focus on. A thorough review of existing literature was done including searches over the internet. The study found that Kenya had about 37 million birds in 2006 of which 84.1% were free-ranging indigenous birds, 8.4% were layers, 5.7% were broilers while other poultry species accounted for 1.8%. About 65% of Kenyan households keep chickens; each household keeps about 12 chickens on average. Poultry are produced in four main production systems, which are labelled Sectors 1 – 4 according to the FAO/OIE classification. Sector 1 consists of the integrated industrial producers (big companies), Sector 2 is made up of hatcheries, and Sector 3 is dominated by smallholder semi-commercial farmers while Sector 4 constitutes the village or "backyard" (traditional) poultry production system. The September 2005 HPAI scare is estimated to have caused a loss of about Ksh 2.3 billion (US$40,000) mainly due to reduced demand for poultry products as consumers shunned away these products. Prices of poultry and poultry products declined due to the scare. For instance, the price of one broiler, indigenous chicken and spent layer declined by 15%, 26% and 29% during the period of the HPAI scare. The price of indigenous eggs fell by 7% while that of the commercial eggs decreased by 15%. Significant gaps in knowledge still remain.

Based on these findings, the study recommends the following:

- There is a need to conduct a poultry population census (possibly together with that of other livestock species) in order to update and validate existing data.
- There is a need to create awareness of HPAI among producers and consumers of poultry products in order to reduce their ignorance on the disease transmission and therefore avert possible losses due to a HPAI scare.
- Compensatory mechanisms should be instituted, possibly through poultry insurance schemes, in order to cushion farmers and businesses in the poultry sector from economic losses associated with a HPAI outbreak or scare of an outbreak.
- The veterinary department should come up with clear guidelines on the appropriate control approaches for the disease (e.g. to vaccinate or not vaccinate).

Research is also needed in the following areas:

- Evaluation of the poultry sector value chains to identify "hot spots" for HPAI entry to aid in designing effective control/eradication strategies;
- Evaluation of different marketing channels of poultry and poultry products with a view to identifying key actors (who are they, how many, what are their incentives, how are they organized, etc) in those channels and their level of awareness of HPAI and its potential threat;
- Evaluation of different segments of consumers with a view to promoting consumer awareness of HPAI risk;
- Evaluation of the cost-effectiveness of alternative HPAI control strategies in the wake of a potential outbreak;
- Appropriate compensation mechanisms that are suitable for the structure of the poultry sector in Kenya;
- Potential losses arising from a disease outbreak or scare;
- Risk analysis as a component of early warning system in risk based surveillance strategy; and
- Impact of the disease and the control measures on the livelihoods of the poor.

1. Introduction

1.1 Motivation

The Highly Pathogenic Avian Influenza (HPAI) is a zoonotic viral disease that affects all poultry species including wild birds. Since its first outbreak in China in 1997, the disease has spread rapidly across Asia, Europe, the Middle East and Africa. At the end of 2006, HPAI had been reported in 67 countries and appeared to be endemic in three – Indonesia, Egypt and Nigeria (ILRI, 2007). Africa is particularly vulnerable to the disease due to its generally poor human and inadequate animal health services, a large backyard poultry population and lack of resources to fight the disease (Geerlings, 2007). In addition to Egypt and Nigeria, outbreaks have been reported in Sudan, Djibouti, Niger, Cote D'Ivoire, Cameroon, Ghana and Togo with enormous economic and socio-cultural consequences (FAO, 2007). Although no outbreak has been reported in Kenya so far, the country is at a high risk of contracting the disease due to its location along the migratory route of wild birds. Additionally, HPAI has been reported in southern Sudan, Kenya's northern neighbour. Illegal trade in poultry and poultry products across Kenya's porous borders increases the risk of transboundary infection. These facts suggest that perhaps it is not an issue of whether HPAI will occur at all in Kenya, but rather, when it will occur. Understanding the status and operations of the poultry sector in Kenya, therefore, could help in identifying "hot spots" of high risk for mitigation measures. The aim of this paper is to document all available information on the poultry sector in order to identify areas that HPAI research in Kenya should focus on.

1.2 Significance and scope

In countries where it has occurred, HPAI outbreaks or scares of an HPAI outbreak have led to the devastation of the poultry industry, thereby not only compromising the livelihoods of millions of people but also putting their lives at risk. In many developing countries, poultry production is an important income generating activity that also contributes to the general economy through its linkage with other sectors. This study reviews the existing literature on the status of the poultry sector in Kenya with respect to HPAI. It provides important information that could be used to design pro-poor HPAI risk mitigation strategies that are sensitive to the needs of the poor and vulnerable groups. The study looks at all aspects of the poultry sector, from production through marketing to consumption.

1.3 Summary of key findings

The study found that Kenya had an estimated 37.3 million birds in 2006, of which 84.1% were free-ranging indigenous birds, 8.4% were layers, 5.7% were broilers while other poultry species (ducks, turkeys, pigeons, ostriches, guinea fowls and quails) accounted for the other 1.8%. About 65% of Kenyan households keep chickens; each household keeps about 12 chickens on average. Poultry are produced in four main production systems labelled Sectors 1 – 4 according to the FAO/OIE classification, which is based on the bio-security levels of the producer. Sector 1 consists of the integrated industrial producers (big companies) with high sanitary and bio-security standards, Sector 2 is made up of hatcheries with moderate to high sanitary and bio-security levels and Sector 3 which is dominated by small-scale semi-commercial farmers with low to medium sanitary and bio-security standards. Sector 4 constitutes the village (so-called "backyard" or traditional) poultry production system. This is a low-input low-output system with minimal sanitary and no bio-security standards.

Incidentally, this system dominates poultry production in Kenya. The poultry production data showed that the Rift Valley Province has the highest population of poultry followed by Nyanza and Central Provinces in that order. Kenya is almost self-sufficient in poultry egg and meat production and it currently does not import or export these products. The September 2005 HPAI scare is estimated to have caused a loss of about Ksh. 2.3 billion mainly due to reduced demand for poultry products as consumers shunned away those products (Kimani, 2006).

Significant gaps in knowledge still remain. For instance, research is needed to understand how to design appropriate compensatory mechanisms to cushion poultry producers and businesses from losses in case of an outbreak. Additionally, studies are needed to evaluate the appropriateness of existing alternative control measures as well as their cost-effectiveness in HPAI control. Both producers of poultry and consumers of poultry products remain ignorant about the disease and its transmission. Except for industrial integrated producers, other poultry keepers observe low bio-security measures at the farm level. On the other hand, consumers need to be educated on the HPAI risk and its potential impact on the poultry industry. The study noted that the data on poultry production, marketing and consumption are widely scattered and sometimes of questionable quality, particularly considering that no poultry census has been conducted since 1976.

1.4 Road map

The first step would be to undertake a poultry population census to update and validate existing data. This could be combined with a census of other livestock species for cost-effectiveness. Awareness is required at producer, consumer and policy maker levels about the disease and its transmission. This could be done using appropriate mechanisms such as mass media, seminars and visits. Research is also needed to elucidate on issues such as appropriate compensation mechanisms, appropriate control/prevention policies (e.g. vaccinate or do not vaccinate?) and evaluation of the cost effectiveness of alternative control or mitigation strategies.

2. Vital country statistics

2.1 Size and location

Kenya is one of the three East African countries and is situated between 34^0-42^0 East and 4^0 North and 4^0 South (Figure 1). The country's total landmass is estimated at about 587,000 Km^2 of which 11,000 Km^2 is water (RoK, 2004). Kenya's boundary extends to 3,477 Km of which 861 Km is the border with Ethiopia to the northeast, 536 Km is the border with Somalia to the east, the Sudan to the north (232 Km), Tanzania to the south (769 Km), Uganda to the west (933 Km) and the Indian Ocean to the southeast (146 Km).

Figure 1 Kenya and its neighbours

Source: CIA (2008)

The country's terrain is characterized by low plains in the periphery which rise to undulating hills and mountain ranges in the central highlands bisected by the Great Rift Valley in the west. The altitude varies from sea level in the Indian Ocean to 5,199 meters (17,057 feet) above sea level on top of the snow-capped Mount Kenya, the second highest mountain in Africa. Kenya's climate varies with altitude, from a tropical climate along the coastal strip to temperate in the highlands and a desert-type in the lowland areas.

On the basis of rainfall, Kenya can be divided into three main production zones:

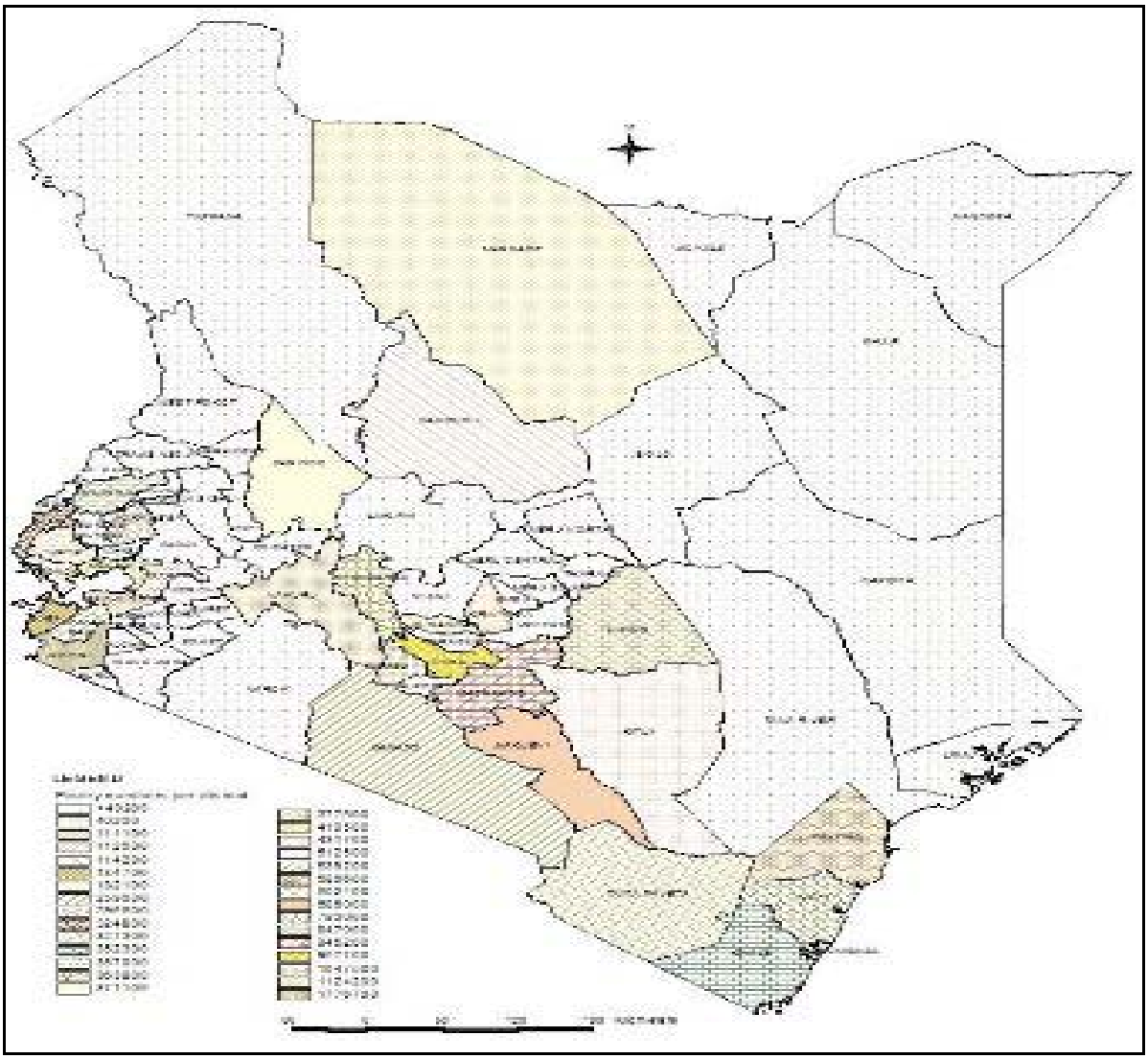
(i) The high rainfall zone, which receives over 1000 mm of rainfall per annum. This area occupies less than 20% of the agricultural land and hosts about 50% of the country's population. Most of the food and cash crops as well as livestock are produced in this zone under semi-intensive and intensive systems. The zone accounts for all the tea, pyrethrum and potato production and about 75% of milk, coffee and vegetables production.

(ii) The medium rainfall zone, which receives between 750-1000mm of rainfall annually and occupies between 30%-35% of the country's land area. It is home to about 30% of the population. Farmers in this zone keep cattle and small stock, and grow drought-tolerant crops.

(iii) The low rainfall zone, which receives 200-350 mm of rainfall annually and inhabits about 20% of the population, 80% of the country's livestock and 65% of the country's wildlife. This zone occupies about 84% of the country's land mass and is classified as arid and semi-arid land (RoK, 2004).

Most of the commercial poultry are located in the high and medium rainfall zone comprising the Central Province, Central Rift Valley and around Mombasa in the Coast Province (Figure 2). High human population growth in these areas has decreased land sizes, thus making poultry production more suitable than other types of livestock production. Very few poultry are reared in the North Eastern Province and parts of the northern and southern Rift Valley.

Figure 2 Distribution of poultry in Kenya



Source: Mulinge et al. (2008)

2.2 National capital and its population

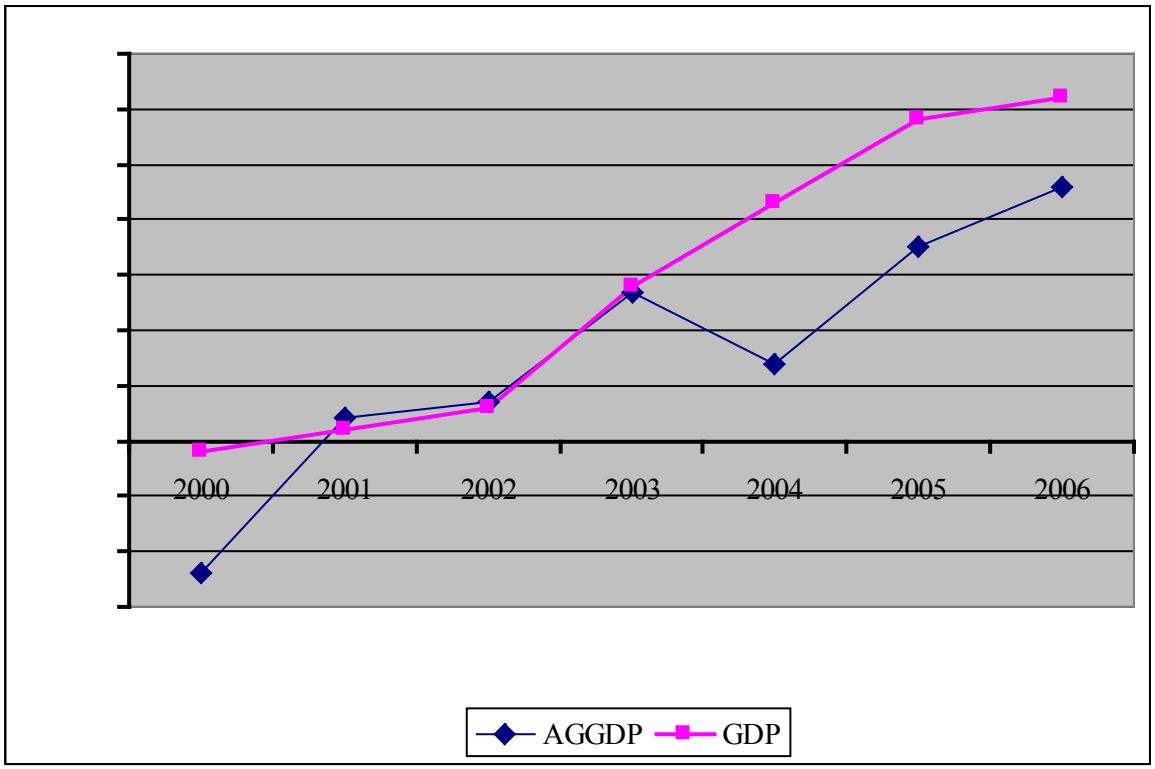
Kenya is the gateway to Eastern and Central Africa. It is also the regional hub for trade, finance and telecommunication. The country has three major cities. The largest city, Nairobi, serves as both the political and commercial capital. The city of Mombasa is the second largest and is situated at the Coast Province, a major tourist destination. Kisumu city is located at the shores of Lake Victoria in the western part of the country. The port of Mombasa services such landlocked countries as Uganda, Rwanda, Burundi, southern Sudan and the eastern part of the Democratic Republic of Congo (DRC). The population of the City of Nairobi was 2,143,254 in 1999, with an intercensal growth rate of 4.8% between 1989 and 1999 (RoK, 2001). Kenya's official language is English while Kiswahili is the national language. Most people speak Kiswahili and a local ethnic dialect of the forty-two ethnic communities.

In the 1999 Population and Housing Census, Kenya's total human population was 28,686,607 people with a density of 49 people per Km^2 (RoK, 2001). Of this population, 80% (22,949,286) reside in the rural areas (RoK, 2004). The annual growth rates of the total and rural population were 2.9% and 3.1%, respectively, between the 1989 and 1999 intercensal period (RoK, 2001).

2.3 Gross domestic product

The country's Gross Domestic Product (GDP) was estimated at $57.7 billion in 2007 (RoK, 2007). Since 2000, Kenya's GDP has been steadily growing from a low of negative 0.2% in 2000 to a high of 6.2% in 2006 (Figure 2). This was largely fuelled by good weather conditions and improved economic management following the installation of the National Rainbow Coalition (NARC) in 2003. As Figure shows, Kenya's economic growth rate is intimately linked with the growth rate of agriculture. Between 2003 and 2007, Kenya's average GDP per capita was $1,084 with a growth rate of 4.3% (RoK, 2007).

Figure 3 Annual growth rates of GDP and agricultural GDP (2000-2006)

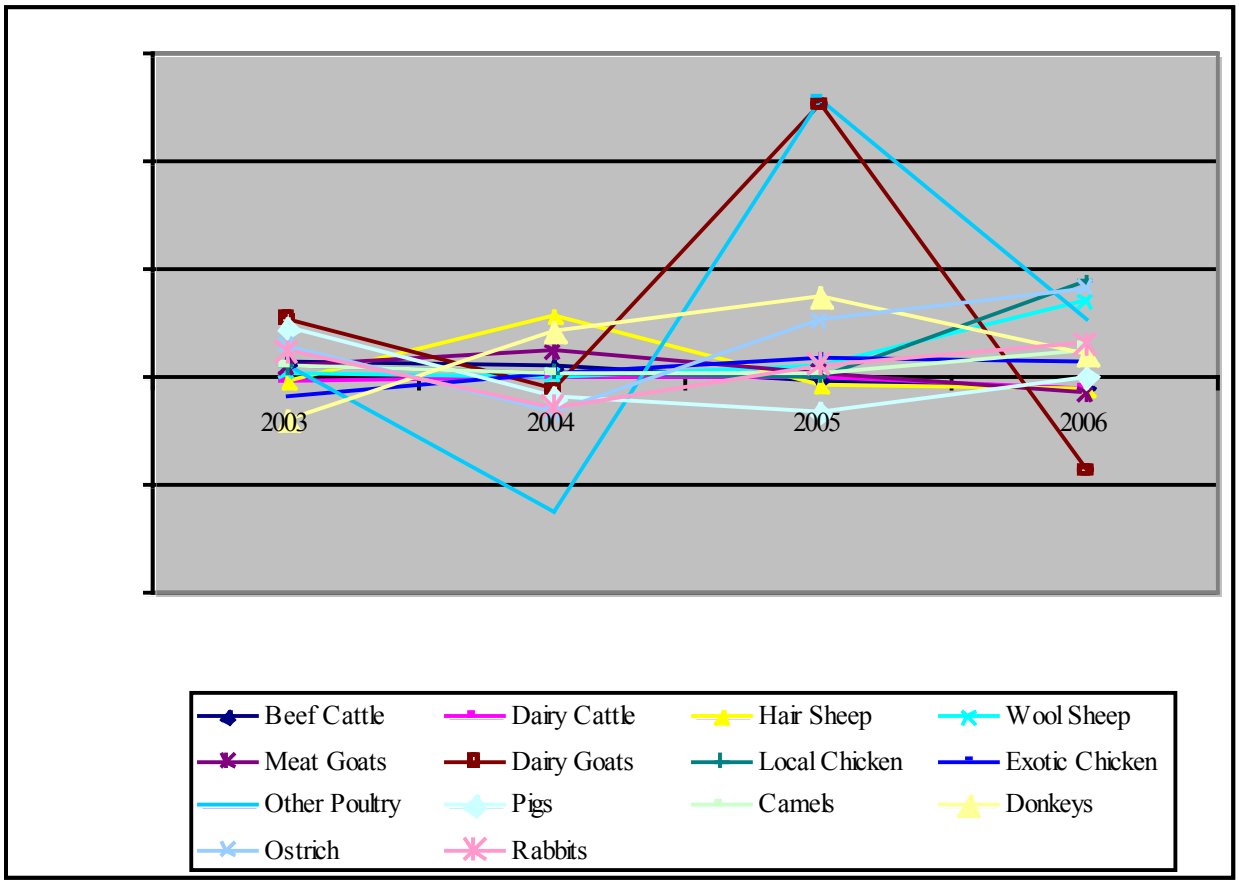


Source: Derived from RoK (2007a)

Agriculture is the backbone of the country's economy contributing about 25% of the total GDP, an equivalent of $14.4 billion in 2007. The agricultural sector provides employment to an estimated 70% of the labour force (RoK, 2007) and also contributes a further 27% indirectly through linkages with manufacturing, distribution and other service sectors and over 75% of industrial raw materials (RoK, 2006). The agricultural GDP (Ag.GDP) grew from negative 2.4% in 2000 to 4.6% in 2006 (Figure 2).

The agricultural sector consists of crop and livestock sub-sectors. The livestock sub-sector contributes about 12% to the GDP and 38% to the agricultural GDP (Irungu and Kimani, 2008). In 2006, Kenya had an estimated 11,479,414 tropical livestock units (TLU)[1] comprising cattle, sheep, goats, donkeys, camels, pigs, poultry (including ostrich) and rabbits valued at Ksh. 264.8 billion (equivalent to US$4.4 billion)[2]. Figure 3 shows the estimated annual growth rate of different livestock species between 2003 and 2006. During this period, dairy goats, indigenous poultry and wool sheep had a dramatic variation, particularly between 2004 and 2005. The cause of this variation is not immediately discernible from the data. However, intensive promotion of dairy goats as an alternative, low cost source of milk could have raised the growth rate of dairy goats. The drought of 2005/2006 also affected the growth rate of large ruminants (cattle, camels and donkeys). The growth rate of other livestock species has been stagnant in the last five years (Figure 3). Data quality could also have contributed to the wide variation in growth rates of different livestock species. It is worth noting that there has been no recent livestock census since 1969, and therefore the numbers reported are based on guesstimates by the Ministry of Livestock personnel.

Figure 4 Annual growth rates of different livestock species (2002-2006)



Source: Derived from MOL data

[1] 1 TLU = 250kg live weight.
[2] 1US$ = Kshs 60

About 69 % of all households in Kenya are engaged in crop farming, and of this population 85.4 % live in the rural areas (RoK, 2007). In addition, 66 % of Kenyan households keep at least one type of livestock. Chicken and cattle are the most common livestock species and are reared by 67 % and 64 %, respectively, of livestock rearing households. Other livestock species include sheep, goats, camels, pigs and donkeys. The proportion of households engaged in crop farming and livestock keeping differs across Kenya's eight administrative regions and is given in Table 1.

Table 1 Number and percentage of households engaged in crop farming and livestock keeping in Kenya's eight provinces

	Households engaged in crop farming		Livestock keeping households	
Region	**Number**	**Percent**	**Number**	**Percent**
Western	736,650	90.0	1,369	79.1
Eastern	1,038,753	88.4	2,186	76.5
Nyanza	968,506	83.8	1,882	71.6
Central	930,538	81.9	1,343	60.2
Rift Valley	1,496,336	66.0	2,817	68.1
Coast	557,944	49.5	1,102	51.4
North Eastern	137,770	9.5	419	58.2
Nairobi	581,486	1.1	476	2.5
Rural	4,975,029	85.4	7,886	84.3
Urban	1,472953	12.9	3,708	26.9
Kenya	6,447,982	68.8	11,594	66.0

Source: RoK (2007a)

2.4 Human Development Indicators

Kenya's Human Development Index (HDI) for 2005 was 0.521, which placed the country at number 148 out the 177 countries considered (United Nations Development Programme (UNDP) Human Development Report 2007/2008). Looking at the specific components of the HDI (life expectancy, education and GDP capita), Kenya's life expectancy at birth is 56 years. The overall literacy rate for the whole country for 15 year olds (and over) is 79 %. About 84 % of men and 74 % of women are literate. The North Eastern Province has the lowest literacy rate in the whole country followed by the Rift Valley Province (Table 2).

Table 2 Literacy rates of 15+ years in Kenya by province and gender

Region	**Overall**	**Males**	**Females**
Nairobi	95.3	96.6	93.9
Central	86.2	91.2	81.7
Nyanza	84.5	91.9	77.9
Western	81.7	87.5	76.4
Eastern	79.0	84.3	74.0
Rift Valley	73.0	77.7	68.2
Coast	70.4	82.1	59.9
North Eastern	28.2	42.4	13.7
Rural	75.7	82.2	69.6
Urban	90.8	93.6	88.1
Kenya	79.0	84.8	73.6

Source: RoK (2007a)

2.5 Administrative regions and their population

Kenya is divided into eight provinces, namely, Nairobi (the capital city), Central, Coast, Eastern, North Eastern, Nyanza, Rift Valley and Western. Table 3 shows the distribution of the human population in the eight provinces during the 1999 population and housing census. About 99% of the population of the city of Nairobi is urban. There is no information on the income per capita generally and the per capita agricultural income in the eight Provinces.

Table 3 Characteristics of Kenya's human population by Province

Region	Total population	Population density	Rural population (%)
Nairobi	2,143,254	3,079	1
Central	3,724,159	282	88
Eastern	4,631,779	30	90
North Eastern	962,143	8	97
Coast	2,487,264	30	89
Rift Valley	6,987,036	38	92
Western	3,358,776	406	89
Nyanza	4,392,196	350	95
Kenya	28,686,607	49	80

Source: RoK (2001)

The intercensal human population growth rates in Kenya's eight provinces have varied, as shown in Table 4. The growth rate fell from a high of 3.4% between 1969 and 1989 to 2.9% in 1999. The population growth rates have been falling in all provinces except the North Eastern, which recorded an unprecedented 9.5% annual growth between 1989 and 1999.

Table 4 Intercensal population growth rates in the eight provinces of Kenya

Province	1969-79	1979-89	1989-99
Nairobi	4.9	4.7	4.8
Central	3.4	2.8	1.8
Coast	3.5	3.1	??
Eastern	3.5	3.3	2.1
North Eastern	4.2	-0.1	9.5
Nyanza	2.2	2.8	2.3
Rift Valley	3.8	4.2	3.5
Western	3.2	3.6	2.5
Kenya	3.4	3.4	2.9

Source: RoK (2001)

2.6 Information gaps

The information reported in this section is mainly based on different government documents. The main gap pertains to lack of information on income per capita generally and per capita agricultural income across the eight Provinces. Also, there are gaps in the regional differences in incomes, sources of income and measures to address regional inequality, especially in incomes, public interventions and resource allocation for development programmes.

3. An Overview of The Economics and Structure of the Poultry Sector

3.1 Contribution of the poultry sector to the GDP

Poultry keeping is one of the most popular livestock enterprises in Kenya due to its low capital space requirements. In 2006, Kenya had an estimated 37.3 million birds (MOLFD, 2007)[3]. Of these, free-ranging indigenous birds comprised 84.1% (31.4 million), 8.4% were layers (3.1 million), 5.7% (2.1 million) were broilers while other poultry species (ducks, turkeys, pigeons, ostriches, guinea fowls and quails) accounted for 1.8% (0.7 million). The main genotypes of commercial layers are Isa Brown and Ross, while commercial broiler genotypes include Arbor Acres, Hybro, Cobb (United Kingdom) and Hypeco (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. 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, 2007).

The poultry sector contributes about 55% to the livestock sector and 30% of the agricultural GDP, or 7.8% of the total GDP (RoK, 2007). The sub-sector employs about two million people directly in production and marketing and indirectly through linkages with suppliers of such inputs as day-old-chicks, feeds and veterinary services. Poultry are a major source of animal proteins and are used in many diets. Poultry also play important social and cultural roles amongst poultry keepers (Njenga, 2005; Kimani, 2006). About 65% of all Kenyan households keep chickens. Each household keeps about 12 chickens on average (Table 5). Only 2% of all households in the North Eastern Province keep chicken; these households also keep the least number of chickens (5.4) in the country. Indigenous birds are mainly reared in the rural areas while commercial birds (broilers and layers) are kept in the outskirts of main urban centres, such as Nairobi, Kisumu, Nakuru and Mombasa. Nairobi Province has the highest number of chicken kept per household (91.3), therefore implying that chicken production in the Province is an important income generating activity (Table 5).

Table 5 Average number of chicken reared by a Kenyan household and percentage of households keeping different numbers of chicken by Province

Region	Average # of chicken kept	Percentage of households keeping these chickens			
		0-10	11-20	21-50	51-100
Nairobi	91.3	50	8.3	25	16.7
Central	13.6	86.2	9.4	2.9	1.3
Eastern	10.9	76.4	16.4	6.3	1
North Eastern	5.4	99.6	0.4	0	0
Coast	17.3	62	21.4	14.8	1.7
Rift Valley	12.1	83	11.7	4.6	0.7
Western	9.5	74.3	16.7	8	0.9
Nyanza	11.5	0			
Rural	11.5	77.4	15.2	6.5	0.9
Urban	14.5	78.9	12.3	6.6	2.3
Kenya	11.9	77.6	14.8	6.5	1.1

Source: RoK (2007a)

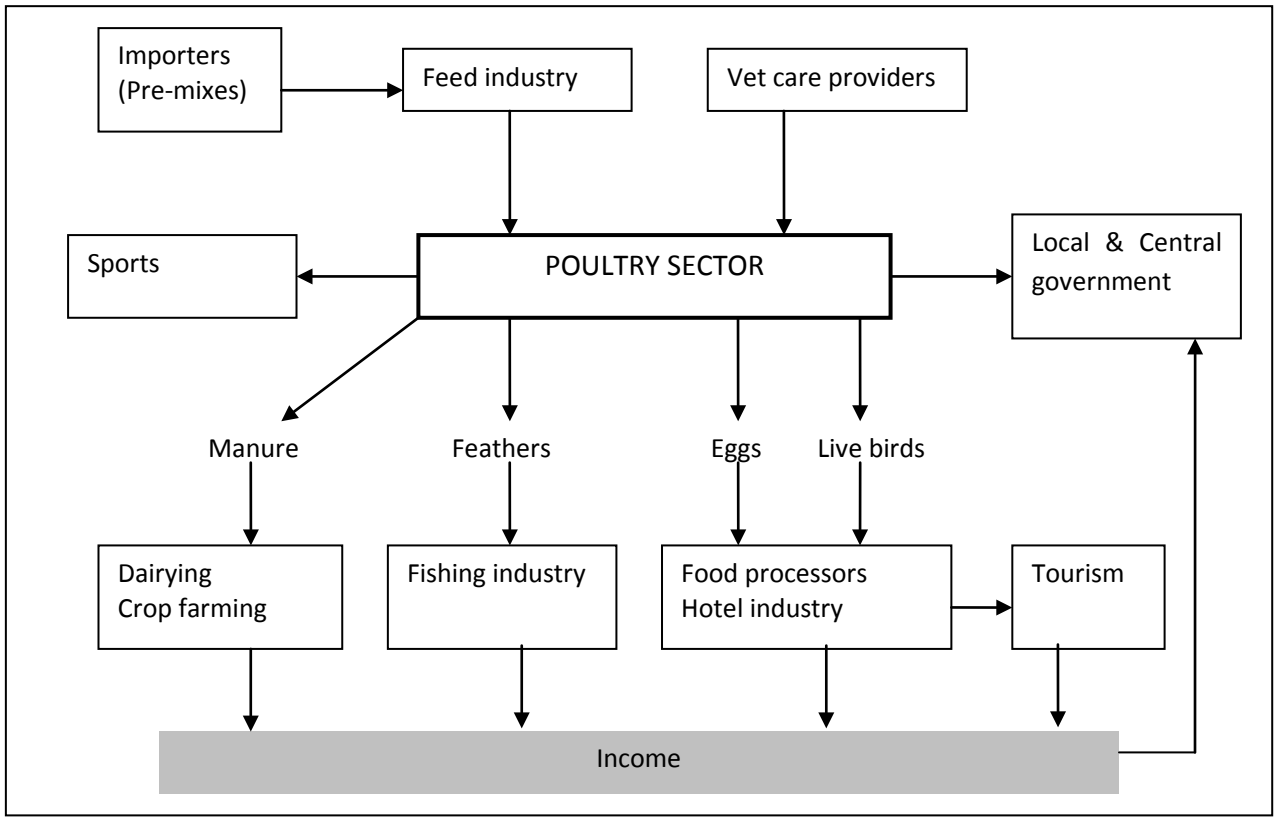
[3]This number varies in different studies; no poultry census has been carried out since 1976.

3.2 Linkage of the poultry sector to other industries

The poultry sector in general is highly integrated with other upstream and downstream sectors within and outside of agriculture. Upstream in the supply chain, the poultry sector integrates with the feed industry (importers of premixes and feed manufacturers) and animal health service providers. Downstream in the value chain, the sub-sector integrates with the farming community (mainly dairying and crop producers via manure), fishing industry (feathers are used to manufacture fishing baits), the food industry (through eggs and poultry meat) and tourism (Figure 4). The poultry sector is also linked with sports and culture; cockerel fighting is a big attraction in some communities in Kenya. Part of the income derived from poultry farming is appropriated as government revenue, the rest forms an important pathway out of poverty, especially among the rural population.

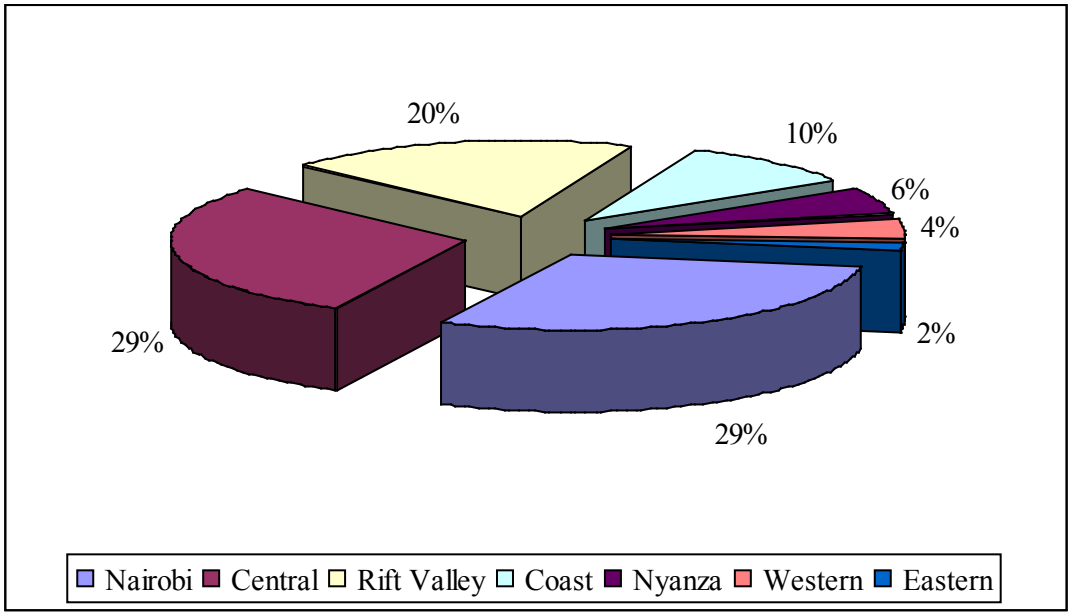
The sectors that the poultry industry are integrated with contribute significantly to Kenya's economy. For instance, the dairy sector contributes about 10% of the livestock GDP (Omiti and Muma, 2002). Crop production contributes about 57% to the agricultural GDP, while agricultural and animal health services contribute about 1% to the agricultural GDP (Irungu and Kimani, 2008). Between 1999 and 2003, the fishing industry accounted for 0.3% of the total GDP (EPZA, 2005). The food industry, where poultry products are mainly consumed, is highly integrated with tourism, which contributes about 19% to the overall economy.

Figure 5 Linkage of the poultry sector with other industries



Although no study has documented the number of people employed in these industries, anecdotal evidence suggests that the number is approximately three million[4]. Feed millers constitute the largest players in the animal feed industry. Animal feed (including poultry feed) is manufactured from imported feed premixes and locally produced cereals – mainly maize, wheat and rice. There were 51 operational poultry feed millers in Kenya in 2004 (MOLFD, 2005). Nairobi and Central Provinces each had 15 millers, representing 58% of all millers. Rift Valley, Coast and Nyanza Provinces had 10, 5 and 3 millers respectively (Figure 5). The large number of feed millers in Nairobi and Central Provinces is an indication of the importance of commercial poultry farming in these areas. It is important to note that indigenous chicken producers rarely purchase commercial feeds.

Figure 6 Proportion of poultry feed millers by Province in 2004



Source: Derived from MOLFD (2005)

3.3 Structure of the poultry sector

In most developing countries, poultry are kept in four main production systems labelled Sectors 1 to 4 on the basis of the level of commercialization and bio-security (ILRI, 2007). Table 6 presents the general characteristics of each sector.

[4]Assuming each of the 1.5 million poultry-keeping households given in Table 9 dedicates 2 of its members to poultry production.

Table 6 Characteristics of poultry production systems in developing countries

Characteristics	Sector 1: Industrial integrated	Sector 2: Commercial	Sector 3: Semi-commercial	Sector 4: Village or backyard
Bird and product marketing	Commercial	Usually commercial	Birds usually sold in live bird markets	Birds and products consumed locally
Bio security	High	Moderate to High	Low to minimal	Minimal
Motivation for production	Profit	Profit	Profit, social	Social; source of household protein
Inputs	High external input use (in housing, feeding, processing)	Housing and feeding; Use of veterinary services	Some inputs with supplementary feeding; housing; limited use of veterinary services	Low input use

Source: ILRI (2007)

Kenya's poultry production can be classified into the four sectors shown in Table 6. The next section describes the characteristics of each of the poultry production systems in Kenya. The information presented here was mainly obtained from FAO (2007).

3.3.1 Sector 1: Integrated industrial poultry production system

This sector is fully industrial with high use of external inputs for housing, feeding and processing (Table 6). The scale of production is large, consisting of several thousand commercial birds. Such farms are integrated with hatcheries that produce day chicks for use on the farm and for sale. Examples include Kenchic Ltd and Muguku Poultry located in Nairobi and Central Provinces, respectively (Table 7). Although these farms have their own hatcheries, they also import parent birds and fertilized eggs as well. However, the proportion of imported stock is unknown.

In this system, birds are reared indoors under stringent bio security procedures. Flock houses have cement floors, walls half stone and the other half wire mesh and roofs made of corrugated iron sheets. Poultry feed is of high quality and is sourced directly from feed manufacturers. In this sector, companies usually contract small-scale out grower farmers to maintain a steady supply of birds. Data on the number of contract farmers are, however, unavailable. In the case of Kenchic Ltd, a contract farmer should be within 50 Km from the city of Nairobi with a flock size of between 3,000 and 12,000 birds. The contracting company usually supplies farmers with poultry feed and veterinary services. It then collects mature birds from farmers for slaughter in its abattoir. Slaughtered birds are then packaged and marketed as processed products. Together with its own production, Kenchic's annual throughput capacity is 2.6 million birds (MOLFD, 2005). A total of 1,253 people are directly employed in this sector (Table 7). Data on the distribution and size of the end market where the outputs from this sector are sold are unavailable.

3.3.2 Sector 2: Commercial poultry production system

This sector consists of commercial hatcheries where poultry is hatched and bred for commercial purposes (FAO, 2007). The hatcheries are grouped in terms of the species of poultry reared. The characterization of this sector includes some aspects of Sector 1 because of the integrated nature of its production.

(a) Chicken hatcheries

On average, chicken hatcheries rear between 10,000-12,000 layer breeders and 10,000-18,000 broiler breeders per farm annually. Each hatchery produces between 300,000-800,000 day broiler chicks and between 750,000-1,200,000 day old layer chicks annually. Except for Sector 1 hatcheries, day old chicks from other hatcheries are sold to small-scale poultry farmers on a non-integrated basis. Most hatcheries attempt to maintain modest to high (especially those in Sector 1) standards of hygiene and sanitation. Table 7 gives the distribution of chicken hatcheries across the administrative regions of Kenya. Data on the number of day old chicks produced by each hatchery are given in Table 10.

Table 7 Distribution of chicken hatcheries in Kenya

Hatchery	Sector	Location	Province	No. of workers (estimate)
Kenchic	1	Nairobi	Nairobi	600
Muguku Poultry	1	Kikuyu	Central	250
Sigma Supplies	2	Nairobi	Nairobi	100
Kenbird	2	Naivasha	Rift Valley	75
Western Kenya Hatcheries	2	Webuye	Western	89
Bixa	2	Mombasa	Coast	102
Lake Chick Hatcheries	2	Kisumu	Nyanza	37
Total				1,253

Source: Derived from MOLFD (2005)

Hatcheries are made of concrete floors with iron sheet roofing. Part of the wall is made of chicken wire mesh. Hatcheries are well linked with most players in the poultry industry and the rest of the economy. Except in the case of Sector 1 hatcheries where chicks are utilized on-farm, most of the day old chicks in the other hatcheries are sold to small-scale poultry farmers. Culled parents are sold to retailers and wholesalers in major towns and urban centres. Manure is largely sold to coffee, flower and dairy farmers.

(b) Turkey hatcheries

The Nyonjoro Nightingale Farm in Naivasha, Rift Valley Province, is the only commercial turkey farm in East Africa. The farm breeds between 30,000-75,000 broiler turkeys annually. The breeding stock is usually imported from the United Kingdom. Turkey feed is sourced from feed manufacturers, particularly Unga Feeds Ltd. Turkey houses are roofed with corrugated iron sheets. The upper walls are made of wire netting with the lower part made of iron sheets and cemented floors. Turkeys are slaughtered when they reach 4-11 kg dressed weight after 4-8 months. Dressed turkeys are sold on a contract basis to Farmers Choice (80%) and Kenchic (20%) who process them further, package and then sell the final product in supermarkets and hotels. The farm also keeps dairy cattle.

(c) Ostrich hatcheries

Ostriches are domesticated from the wild under license from the Kenya Wildlife Services. There are four licensed ostrich farms in Kenya (Table 8). However, only the Maasai Ostrich Farm is operated as a commercial venture. The farm has a feed manufacturing factory and storage. Birds are slaughtered on site. The number of ostriches kept on each farm is unknown.

Table 8 Licensed ostrich farms in Kenya

Farm	Location	Province	No. of workers (estimate)
Ostrich Farming	Naivasha	Rift Valley	12
Ukunda Farm Park	Ukunda	Coast	5
Kedowa Ostrich Farm	Kericho	Rift Valley	17
Maasai Ostrich Farm	Kajiado	Rift Valley	26

Source: FAO (2007)

(d) Duck hatcheries

There is only one commercial duck hatchery farm in Kenya, the Ruaraka Duck Farm, and it is located along Thika road in Central Province. However, since 2006, the farm relocated to Naivasha in the Rift Valley. Ducks are hatched, bred and slaughtered on the farm. Dressed carcasses are sold in Nairobi for further processing by a meat processing and packaging company. The farm employs 15 workers. Duck feed is bought from feed manufacturers, such as Unga Ltd.

(e) Mixed species hatchery

An example is one farm, whose name is unknown, located at the north coast in Mombasa, Coast Province. It hatches guinea fowls, quails and ducks and grows them to 6-8 weeks. Guinea fowls are sold in Nairobi.

3.3.3 Sector 3: Semi-commercial poultry production system

This sector comprises small scale producers who keep between 100-4,000 layers and between 300-2,000 broilers per farm for commercial purposes. Most of these farmers purchase day old chicks directly from established hatcheries; others are provided the chicks by the large scale poultry producers in the integrated industrial system (Sector 1) on a contractual basis. Kimani (2006) reports that small-scale poultry farmers derive 73% of their income from poultry (Table 17).

(a) Broiler farms

There were 23,661 broiler farms in Kenya in 2006 (Table 9). Day old chicks are sourced from established hatcheries. Poultry feed is mostly purchased from agro-vet shops. Feed quality is often variable and constitutes a major production constraint. Broiler houses usually have earth floors but half of the walls are wire netting while the bottom half is made of mud walls, wooden planks, iron sheets or stone walling, depending on the financial ability of the farmer. Corrugated iron sheets are normally used for the roofing.

Table 9 Number of poultry farms in the commercial, semi-commercial and village production systems by Province

Province	Commercial (Sectors 1 & 2)	Semi-commercial (Sector 3)		Village Poultry (Sector 4)		Total
		Layers	Broilers	Indigenous	Others	
Rift Valley	1	1,975	1,132	559,266	393	562,767
Coast	1	1,088	1,030	131,457	213	133,789
Western	1	523	88	176,905	105	177,622
Nyanza	1	1,072	639	252,076	217	254,005
Central	1	4,902	10,750	115,252	980	131,885
Eastern	0	783	558	255,281	0	256,622
N/Eastern	0	6	0	9,493	0	9,499
Nairobi	2	962	9,464	7,833	192	18,453
Total	7	11,311	23,661	1,507,563	2,100	1,544,642

Source: Derived from MOLFD (2005); RoK (2007a)

Poultry production in this sector is not integrated. In the urban and peri-urban areas, about 99% of the broilers are sold dressed while the remaining 1% are sold as live birds. Farmers act independently since there is no cooperative for selling poultry meat. Slaughtering of broilers is done at home, usually without any inspection by a veterinary or medical personnel (FAO, 2007). In the urban and peri-urban areas, however, poultry meat is usually inspected by a government meat inspector, who also issues movement permits to facilitate transportation to markets. Once processed, broilers are packed and transported directly to the market. Some farmers store poultry carcasses in deep freezers until they get orders to supply niche markets. Some of these farmers also buy broilers from neighbours to meet demand. Some small scale broiler producers are contracted by producers in both the integrated industrial (Sector 1) and commercial (Sector 2) production systems. Own consumption is restricted to culled chickens and does not form part of the marketed output.

Poultry houses may or may not be cleaned or disinfected before the next intake, depending on the hygiene awareness and the resource endowment of the farmer. Houses are open and infection can get into the flocks through a wind-borne route. Movement of personnel close to the flock houses is generally not restricted. The data on the number of people employed in this sector are generally lacking.

(b) Layer farms

Layer farms were almost of broiler farms in 2006, at 11,311 (Table 9). These farms obtain day old layer chicks and feeds from the same sources as the broiler farms. Some commercial layer farmers also keep broilers, but the majority keep only layers. As in the case of broiler farms, layer farms under this production system are not integrated with hatcheries. Each layer house usually accommodates between 200-4000 birds at a time. Farmers who keep larger numbers usually maintain high standards of hygiene and sanitation. Houses usually have earthen floors with either timber or stone walls. Eggs are collected daily and accumulated to the number of trays that are on order. Freelance farmers, on the other hand, just pack the eggs in trays of 30 eggs and sell them in local markets. Culled hens are sold either on the farm or in primary markets. Birds are usually transported to markets on top of public passenger vehicles or in open pickup trucks. Manure is usually sold to dairy and crop producers. Data on the number of people engaged in layer keeping are not available.

3.3.4 Sector 4: Village (traditional) poultry production system

This sector comprises indigenous chicken, ducks and turkeys and other poultry types kept in the rural areas and in the urban informal settlements. The numbers kept vary with region, species and consumption needs. This is a low-input, low-output production system which involves low income households.

(a) Indigenous chickens

There were about 31.4 million indigenous chickens in 2006 (MOLFD, 2007), kept by about 1.5 million farms in Kenya (Table 9), which translates to 20.8 indigenous birds per farm. The hen: cock ratio is 7:1; an indigenous hen produces 60 eggs per year on average (FAO, 2007), of which only 40% survive (Kitalyi, 1997). Indigenous birds are usually slaughtered at an average dressed weight of 1.5kg per bird. Indigenous chickens are kept both for home consumption and for sale. The estimated annual off take rate for sale is 10% (or 2 chickens on average) per household. Fifty percent of the eggs produced are eaten at the household level, the rest are sold either at the farm gate or in the local markets.

Initial breeding hens and cocks are obtained as gifts from friends and neighbours or from local markets. Thereafter, the breeding stock is selected from the growers in the home. The birds scavenge for feed in the home environment, which is supplemented with left over food, maize, cassava and sweet potatoes (FAO, 2007). Indigenous poultry farmers rarely purchase commercial feed or seek veterinary services for their birds, unless the situation warrants it (e.g. during periods of poultry disease outbreak).

In most cases, indigenous chickens are kept in a separate house that is located near the main house for security purposes. In some communities, chickens are kept in the family house during the night. In some instances, chicken houses are elevated above the ground. Such houses usually have wooden floors and walls with either grass thatched or iron sheet roofs. In other cases, houses are usually not elevated and have earthen floors, mud walls and thatched roofs.

Indigenous birds are usually transported to the market on foot, by bicycle or by motor vehicles. Individual birds are sold at retail satellite chicken markets while eggs are sold in kiosks.

The number of people who directly depend on indigenous chickens for their livelihood is unknown. Indigenous poultry meat and eggs are increasingly gaining popularity in major urban centres in Kenya due to changing consumer preferences associated with desirable health characteristics, such as lower saturated animal fats and lower cholesterol levels. However, the extent to which this change is driving the local demand for indigenous chicken is unknown.

(b) Indigenous turkeys and ducks

These are mainly kept in the peri-urban areas of major towns, in informal urban settlements and the rural areas. Households typically keep 2-6 turkeys and/or ducks mainly as a hobby, although they may be sold when need arises. It is estimated that there are about 30,000 turkeys in this production system (FAO, 2007). Turkeys produce 4-6 chicks twice a year, depending on feed quality, presence of a turkey tom and husbandry practices. Only minimal bio-security measures are carried out in these farms.

3.4 Poultry production, marketing, consumption and trade

3.4.1 Production of day old chicks by main hatcheries

The number of day old chicks produced by the main hatcheries in Kenya in 2004 is given in Table 10. Kenchic is the largest hatchery in Kenya, accounting for about 70% of day old chicks produced in the country. Muguku and Kenbrid follow in the second and third positions, respectively.

Table 10 Estimated number of day old chicks produced by main hatcheries in Kenya in 2004

Hatchery	Province	Million		
		Layers	Broilers	Total
Kenchic	Nairobi	2.9	10.1	13.0
Muguku Poultry	Central	0.4	0.8	1.2
Kenbird	Rift Valley	0.8	0.3	1.1
Sigma Supplies	Nairobi	0.3	0.7	1.0
Bixa	Coast	0.6	0.4	1.0
Lake Chick Hatcheries	Nyanza	0.5	0.2	0.7
Western Kenya Hatcheries	Western	0.3	0.2	0.5
Total		5.8	13.6	18.5

Source: FAO (2007); MOLFD (2007)

3.4.2 Production of live birds

The total poultry population in Kenya varied greatly between 2001 and 2006 (Table 11). Rift Valley Province had the highest poultry population followed by Nyanza and Central Provinces. As expected, indigenous chickens form the largest proportion of the total poultry population in each year.

Table 11 Poultry population in Kenya by Province between 2001 and 2006

		Millions				
PROVINCE	YEAR	Broilers	Layers	Indigenous	Other	Total
Central	2001	2135.3	948.9	1492.2	60.6	4637.0
Coast	2001	165.5	245.4	2005.8	151.0	2567.6
Eastern	2001	143.0	210.4	3714.9	9.0	4077.4
Nairobi	2001	2208.83	190.5	94.98	8.315	2502.6
North Eastern	2001	0.2	1	0	0	1.2
Nyanza	2001	24.3	241.1	4533.4	99.1	4898.0
Rift Valley	2001	314.7	387.9	4696.9	142.1	5541.6
Western	2001	14.8	112.7	2534.0	143.8	2805.3
TOTAL		**5,006.63**	**2,337.9**	**19,072.18**	**613.915**	**27,030.7**
Central	2002	2260.9	879.3	1567.8	65.7	4773.6
Coast	2002	257.6	122.7	1702.9	73.1	2156.3
Eastern	2002	154.1	222.8	3511.4	44.7	3933.0
Nairobi	2002	2358.7	78.977	106.691	3.318	2547.7
North Eastern	2002	0.28	1.3	234.335	0	235.9
Nyanza	2002	165.7	239.2	4872.4	131.2	5408.5
Rift Valley	2002	267.1	368.2	5294.6	102.3	6032.1
Western	2002	11.2	101.4	2508.5	163.0	2784.2

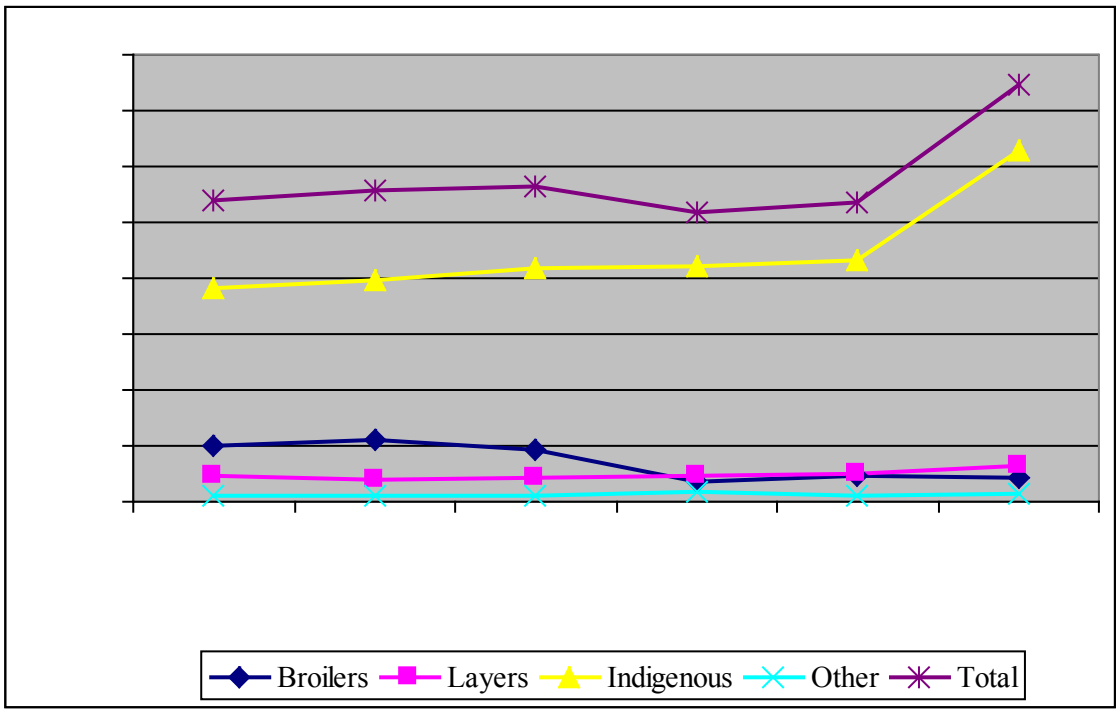
TOTAL		**5,475.58**	**2,013.877**	**19,798.626**	**583.318**	**27,871.3**
Central	2003	1533.8	1089.1	1390.0	78.5	4091.4
Coast	2003	210.5	157.4	1899.3	96.9	2364.1
Eastern	2003	135.0	198.6	3674.4	29.4	4037.4
Nairobi	2003	2237.8	48.933	41.4	2.13	2330.3
North Eastern	2003	0.21	1.08	136.492	0	137.8
Nyanza	2003	113.0	215.8	5735.2	124.3	6188.3
Rift Valley	2003	327.1	407.8	5390.3	85.7	6210.9
Western	2003	14.3	100.6	2610.2	197.6	2922.7
TOTAL		**4,571.71**	**2,219.313**	**20,877.292**	**614.53**	**28,282.9**
Central	2004	350.7	968.7	1748.6	61.9	3129.9
Coast	2004	329.3	209.5	1524.5	210.2	2273.5
Eastern	2004	111.1	156.3	3844.2	29.2	4140.8
Nairobi	2004	692.73	192.367	117.496	4	1006.6
North Eastern	2004	0	1.08	142.436	0	143.5
Nyanza	2004	128.4	213.7	5416.1	118.5	5876.7
Rift Valley	2004	225.8	384.9	5547.7	153.5	6311.9
Western	2004	18.5	114.9	2662.4	227.0	3022.7
TOTAL		1,856.53	2,241.447	21,003.432	804.3	25,905.6
Central	2005	464.2	1232.3	1947.2	42.0	3685.7
Coast	2005	79.4	248.0	2153.5	133.6	2614.5
Eastern	2005	91.3	128.3	3549.3	19.2	3788.1
Nairobi	2005	1064.2	209	157.1	11	1441.3
North Eastern	2005	0.8	1.3	141.5	0	143.6
Nyanza	2005	133.0	219.3	5435.4	36.9	5824.6
Rift Valley	2005	397.8	258.0	5758.8	126.9	6541.5
Western	2005	23.6	116.5	2517.6	159.7	2817.4
TOTAL		2,254.3	2,412.7	21,660.4	529.3	26,856.7
Central	2006	440.9	1079.2	1787.0	35.6	3342.7
Coast	2006	269.1	249.3	2093.3	126.3	2738.0
Eastern	2006	112.6	165.0	3864.8	24.1	4166.4
Nairobi	2006	957.78	188.093	141.351	10.022	1297.2
North Eastern	2006	0.3	0.174	164.981	0	165.5
Nyanza	2006	48.2	203.6	12244.8	46.8	12543.3
Rift Valley	2006	281.4	1139.8	8475.9	167.5	10064.6
Western	2006	17.8	113.1	2644.1	260.7	3035.7
TOTAL		2,128.08	3,138.267	31,416.232	671.022	37,353.4

Source: MOLFD (Various Annual Reports)

N.B. There are no data on seasonal production and prices of poultry and poultry products.

The trend in the poultry population is shown in Figure 6. The population of indigenous chickens has been rising since 2005, while that of commercial chickens (broilers and layers) began declining in 2003 and has been decreasing ever since.

Figure 7 Trends of poultry population in Kenya (2001-2006)



Source: Derived from MOLFD (Various Annual Reports)

3.4.3 Egg and poultry meat production in Kenya

The current and projected production and demand for eggs and poultry meat in Kenya for the 2004-2010 period is given in Table 12. Kenya is generally self-sufficient in eggs and poultry meat. The demand for eggs is expected to outstrip supply in 2010; the demand[5] for poultry meat will just balance supply over the same period (Table 12).

Table 12 Production and demand projections for eggs and poultry meat in Kenya (2004-2010)

Product		2004	2005	2006	2007	2008	2009	2010
Eggs ('000 million)	Production	1.1	1.2	1.2	1.2	1.3	1.3	1.3
	Demand	1.0	1.0	1.1	1.1	1.1	1.2	1.2
	Surplus	0.1	0.2	0.1	0.1	0.2	0.1	0.1
Poultry meat ('000 Tonne)	Production	23.2	23.8	24.4	24.9	25.6	26.2	26.9
	Demand	23.0	23.6	24.3	24.9	25.6	26.2	26.9
	Surplus	0.2	0.2	0.1	0.0	0.0	0.0	0.0

Source: Kiptarus (2005); MOLFD (2007)

[5]It is not clear from MOLFD (2007), how this demand was estimated.

3.4.4 Egg and poultry meat consumption in Kenya

It was difficult to obtain egg and poultry meat consumption data disaggregated by region, as the MOLFD does not record the consumption of poultry and poultry products. An undated and untitled report from the MOLFD indicates that the average annual per capita consumption of chicken meat and eggs is 0.64 kg and 37.5 respectively. There is no reference to the spatial or temporal aspects of consumption estimate. Table 13 shows the current retail price range of live chickens in Nairobi. The price varies with seasonal demand. E.g., prices are higher during Christmas, Easter and Ramadhan. Chicken egg prices also vary with season. For example, a tray of 30 eggs retails between Ksh 130 and 150 in Nairobi, which translates to Ksh 4.3 – 5 per egg.

Table 13 Average retail prices of chicken in Nairobi, 2008

Type of bird	Price per bird (Ksh.)
Indigenous	250-500
Broiler	200-250
Culled layer	150-180

Source: Based on an undated and untitled reported from the Poultry Division, MOLFD
N.B. There are no data on the marketing margins.

3.4.5 Value and volume of imports and exports of poultry products

Currently, Kenya does not import or export any chicken meat. However, other poultry products are traded, as shown in Table 14. Data on the value of these products are missing. Day old chicks are the major exports while hatching eggs are the major imports. A substantial number of day old chicks are imported as well.

Table 14 Export and imports of different poultry products in Kenya between 2002 and 2006

Year	Exports				Imports							
	Hatching eggs	Turkeys	Day old chicks	Parrots	Parrots	Pelicans	Frozen chicks	Ducklings	Guinea fowls	Live birds	Hatching eggs	Day old chicks
2002	16,776	2	126,750	1	11	0	0	430	0	0	79,560	88,088
2003	0	0	54,302	1	2	1	870	1,703	20	18	495,080	0
2004	0	0	145,492	4	20	0	0	0	0	0	5,986,865	116,614
2005	0	0	0	0	0	0	0	0	0	-	0	0
2006	0	0	47,700	0	0	0	0	0	0	5,374	407,880	78,340

Source: Derived from FAO (2007)

3.4.6 Status of HPAI in countries where poultry products are exported to and imported from

Kenyan poultry products, especially hatching eggs and day old chicks, are exported to the neighbouring countries – Uganda, Tanzania and Ethiopia. Data on the volume of exports are not available. None of these countries has so far reported any incidence of HPAI. In February 2006, there were rumours of avian flu in Ethiopia. Subsequent laboratory tests, however, did not reveal any case.

Kenya imports poultry breeding stock (parent birds, fertilized eggs and day old chicks) mainly from Uganda, Mauritius, Holland, Egypt, India and South Africa. Commercial turkeys are mainly imported from the United Kingdom and the USA. Data on the volume of imports are not available. Egypt reported its first case of HPAI in 2003, while both Holland and India reported theirs in 2006. So far,

only Holland has managed to contain the disease; Egypt and India are still grappling with the disease. Kenya has since banned imports from these countries, including Uganda, to minimize the risk of HPAI. Producers of day old chicks from Uganda have been complaining about unfair trade because Uganda has not had any reported case of HPAI, yet Kenya exports day old chicks to Uganda weekly[6]. No efforts have been made to re-open the border. However, illegal poultry trade continues unabated between Kenya and her neighbours (Mulinge et al., 2008).

3.4.7 Proportion of poultry from various sectors that enters the wet market system

Data on the proportion of poultry from various sectors that enters the wet market system are not available. Preliminary data from an ongoing study indicates that about 80% of poultry in the semi-commercial sector and 30% of indigenous poultry enters the wet market system (Dr T. Kimani, Personal Communication[7]). Poultry produced in the industrial (commercial) sector does not enter into the wet markets.

3.4.8 Major value chains for the poultry sector and traceability systems

The Kenyan poultry industry is dominated by chickens. There are two main chicken production systems: (i) the commercial system which produces broilers and eggs (Sectors 1-3 according to the classification described above), and (ii) the village (or traditional) system which is dominated by indigenous chickens and eggs (Sector 4). The value chains for the two systems are described below. Other poultry species – turkeys, ducks, pigeons and quails – constitute a minor segment of the poultry sector in Kenya. However, in the event of an avian influenza outbreak, such birds could be an effective entry and transmitter of the H5N1 virus through their contact with both wild and domestic birds.

(a) Value chain for commercial chickens and eggs

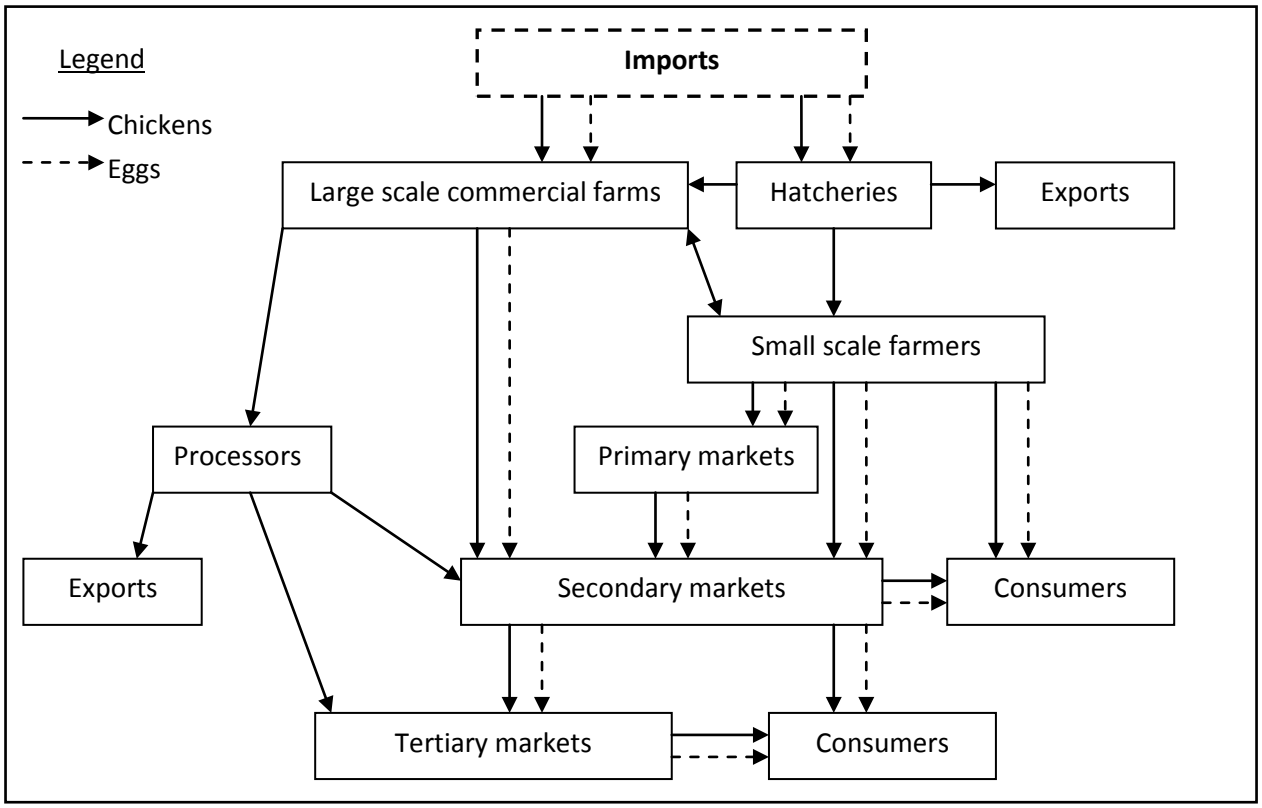
Figure 6 shows the value chain for commercial chickens and eggs in Kenya. The industrial integrated sector imports poultry breeding stock (parent birds or fertilized eggs) mainly from Mauritius, Holland, Egypt, India and South Africa. Hatcheries sell day-old chicks to local commercial and smallholder farmers while the rest is exported to the neighbouring countries, mainly Uganda, Tanzania and Ethiopia. Large commercial farms sometimes contract smallholder farmers and supply them with day-old chicks and feed. Some of the eggs produced in large scale farms are exported. The rest are sold in secondary and tertiary markets. Some chickens are also sold to meat processors who either sell them locally in secondary and tertiary markets or export certified brands, e.g. Halal Chicken. Smallholder farmers sell their eggs and chicken in primary markets in their vicinity or directly to secondary markets. Contract farmers deliver part of their produce to large scale farms. Secondary markets supply supermarkets, restaurants and consumers in urban areas. Traders in secondary markets eventually sell mostly to tertiary markets – restaurants and hotels as well as to urban consumers. Data on the proportion of birds and eggs exchanged at each stage of the value chain are not available.

[6]See http://www.voanews.com/english/Africa/Ugandan-Poutry-Traders-Accuse-Kenya.cfm and http://allafrica.com/stories/200802112071.html)

[7]Dr Tabitha Kimani is the Head of Socio-economics Section at Kenya's Department of Veterinary Services, Veterinary Research Laboratories, Kabete.

Although the structure of the commercial system offers an opportunity to implement traceability systems, none has been instituted so far.

Figure 8 Market channels for commercial chickens and eggs in Kenya

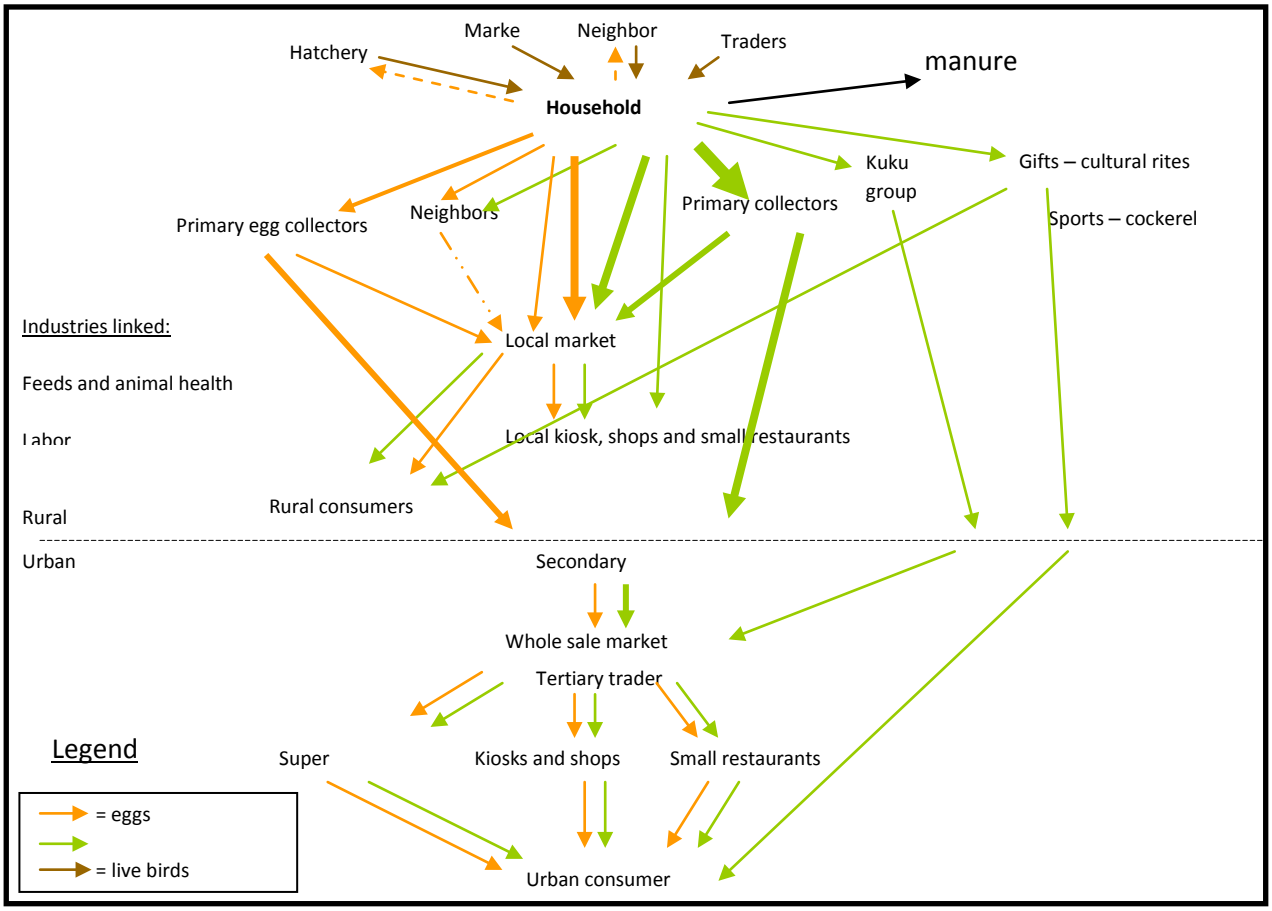


Source: Dr. Tabitha Kimani (Personal Communication)

(b) Value chain for indigenous poultry

Figure 7 shows the value chain for indigenous chickens and eggs in Kenya. Farmers source indigenous chickens from neighbours, hatcheries, markets and relatives. The chicken keeping households sell live birds either directly in the local markets or to primary collectors (middlemen), who eventually sell in local markets, which include individuals, kiosks, shops and small restaurants mainly in the rural areas. Primary collectors also sell some chicken in secondary markets in the urban areas. Some of these secondary traders sell to the tertiary markets who distribute the chickens to supermarkets, kiosks and small restaurants in the urban areas. Eggs from the chicken keeping households are sold to (i) neighbors, (ii) primary egg collectors and (iii) directly to the local market (Figure 7). Primary collectors and local market operators then sell the eggs in secondary markets in the urban areas from where they are then sold to tertiary markets. Like in the case of commercial chicken, the proportion of chicken traded at each stage of the value chain is unknown. In addition, no traceability mechanisms have been instituted in this system. Such a mechanism would face a challenge because this production system is highly informal and is not as organized as the commercial production system.

Figure 9 Market channels for indigenous chickens and eggs in Kenya



Source: Dr Tabitha Kimani (Personal Communication)

3.5 Knowledge gaps

The main knowledge gaps include:

- Actual poultry population in the country given that the last census was carried out in 1976 (experts and practitioners do not seem to be sure of the exact dates). Lack of such data constrains planning by stakeholders in the poultry industry.
- Lack of information on the number of people actually involved in poultry production across the four sectors. Such information would be easily obtained were a census conducted.
- Lack of information on the volume and value of poultry products moving along the marketing channel(s) including value of exports and imports.
- Lack of information on the proportion of poultry from various sectors that enter into the wet market system. Such information could be useful for planning for preparedness in case of an outbreak.

4. Poultry and rural livelihoods

4.1 Backyard poultry production – labour and gender issues

The term "backyard poultry" refers to any poultry, irrespective of the genotype, that are kept in small numbers in an urban or peri-urban setting for commercial or social purposes (FAO, 2007). The birds could be layers, broilers or indigenous chickens, ducks, turkey, geese, quail or guinea fowls. They may be kept in enclosures or in free range but are housed indoors at night. The number of birds may range from as few as six to as many as 100 or more, either as one type or in mixed flocks.

Kimani (2006) assessed gender issues in poultry production in 319 households distributed in eight districts in Kenya (Table 15). The study sought to document the social and economic impacts of the HPAI scare that occurred in September 2005.

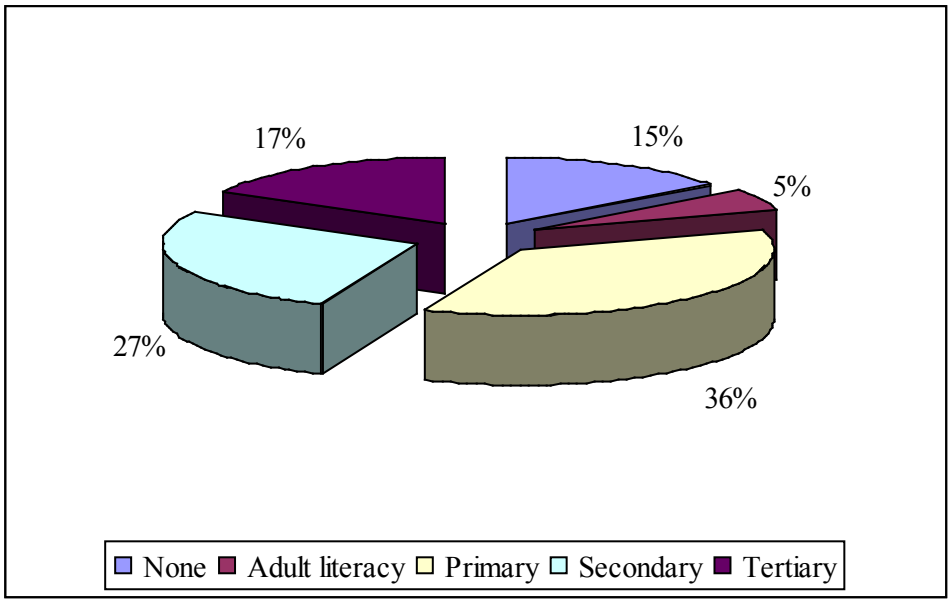
Table 15 Distribution of households surveyed

District	Province	Division	Number of households interviewed
Kakamega	Western	Kabras, Kakamega Municipality	39
Kiambu	Central	Kiambu Municipality, Githunguri, Kiambaa	44
Machakos	Eastern	Central, Kathiani, Mwala	41
Mombasa	Coast	Changamwe, Kisauni	42
Nairobi	Nairobi	Dagoretti, Kasarani	42
Nakuru	Rift Valley	Bahati, Nakuru Municipality	35
Taita	Coast	Mwatate, Wundanyi	43
Uasin Gishu	Rift Valley	Moi's Bridge, Soi, Turbo	33
Total			319

Source: Kimani (2006)

About 86% of the chicken-keeping households were headed by men. The mean age of the household heads was 51 years, which implies a wide agricultural experience. The proportion of household heads in various categories of formal education is shown in Figure 10.

Figure 10 Proportion of household heads in different education categories



Source: Derived from Kimani (2006)

In terms of gender roles in decision making in poultry production, women are the main decision makers by virtue of their control of poultry assets (income) in most Kenyan communities; other livestock (cattle, sheep and goats) are mostly owned by men. Women control most of the income from eggs and live birds (Table 16).

Table 16 Proportion of household members deciding and obtaining income from eggs and live birds

Decision maker	Source of income (%)	
	Eggs	Live birds
Both husband & wife	10.0	10.6
Household head – man	7.6	11.8
Household head – woman	10.5	11.8
Others	2.3	0.8
Wife	69.6	65.0

Source: Kimani (2006)

In general, in the village poultry production system, women are involved in the rearing of chickens and marketing of eggs and live birds. Buyers at the farm gate are usually men who act as primary and secondary collectors. Local turkeys and ducks are usually owned and reared by women (FAO, 2007). However, subsequent marketing is entirely a male affair. Quails, a delicacy in western Kenya, are usually reared and marketed by women. In Burma wet market in Nairobi, women sell offals (intestines and gizzards), chicken legs and feathers; men usually purchase the feathers for making fish baits.

Although there is no information on the extent of involvement of vulnerable family members (e.g. children), elderly and the invalids in poultry production and marketing, Kristjanson et al., (2004) indicate that the first livestock asset that poor households in Western Kenya acquire in their progress out of poverty is chicken, after which they are able to buy either a sheep or a goat before they are

able to buy a local cow. The same study noted that the elderly, who had slid into poverty as a result of funeral expenses, reared only chickens. One can therefore say that poultry plays a vital role in the livelihood of vulnerable members of the Kenyan society.

4.2 Importance of poultry in household income

Table 17 presents the mean annual income from various sources for the 319 households surveyed by Kimani (2006). The data indicate that the poultry enterprise is an important income generating activity in the sample households where it contributed 73% of the household income. Note though that Kimani (2006) did not include income from crop sales for unexplained reasons.

Table 17 Mean annual income from various sources for the 319 households surveyed)

Income source	Mean annual income (KSh.)	Proportion of total income
Live bird sales	335,422	57.9
Egg sales	87,537	15.1
Milk sales	36,466	6.3
Live cattle sales	7,735	1.3
Chicken waste as crop manure	2,808	0.5
Chicken waste as animal feed	1,364	0.2
Sheep & goat sales	1,061	0.2
Off-farm income	106,711	18.4
Total	579,104	99.9

Source: Kimani (2006)

4.3 Importance of poultry in nutrition and food security

The use of poultry as a source of food is very important, as there are few alternative animal protein sources available for the poor (Njenga, 2005). Poultry meat and eggs contribute to a well balanced diet, as there are few cultural or religious taboos that hinder the consumption of these products. According to Kimani (2006), the provision of animal proteins in the form of eggs and meat for household consumption was the most important reason for keeping poultry among the 319 households interviewed (Kimani, 2006).

Although no study exists on the main sources of micronutrients in the rural areas of Kenya, anecdotal evidence suggests that starch (mainly from maize and rice) accounts for the largest proportion in the diet of many Kenyans. In fact, maize is the staple food for a majority of Kenyan communities. Starch is mainly supplemented with leafy greens – mostly kale and traditional vegetables. Meat and eggs are rarely consumed in the rural areas, except during special occasions. In a recent study of sources of micronutrients in the Embu District, McClean et al. (2007) found that animal source foods provided only 4.2% of total energy, of which 21.5% was from meat, 73.8% from milk and 4.7% from eggs. Meat provided 27.7% of the vitamin B-12 in the diet, compared with 70.0% from milk and 2.3% from eggs. Fish consumption is prevalent in Nyanza, Western and Coast Provinces. Animal based foods provide such micronutrients as vitamin A, iron, zinc and vitamin B-12. There are no data on the number of times a week or month an average Kenyan household consumes poultry meat and eggs.

4.4 Importance of poultry in local culture and/or religion

Poultry play important socio-cultural roles in the Kenyan society. For example, poultry are slaughtered during religious festivals such as Easter and Christmas for Christians and Ramadhan for Muslims. Also, poultry are a delicacy in New Year celebrations, birthday parties, weddings and funerals. Poultry are slaughtered during public holidays, which in Kenya include Labour Day, Madaraka, Moi Day, Kenyatta Day and Jamhuri Day. Poultry, and particularly chickens, are used for entertainment, e.g., in cockerel fighting, a popular entertainment activity in Western Kenya. Poultry are also used in traditional rites. For example, in the Kwale District in Coast Province, Njenga (2005) found that plumage colour, cover and sex were the most important considerations in traditional rituals where red/brown and black colours were the most preferred. Poultry are also used for medicinal purposes, e.g. for unblocking ears, and aesthetic values. They also serve as a source of prestige where the number of poultry owned is considered an important status symbol. Some of the roles played by poultry as reported by the 319 respondents interviewed by Kimani (2006) are given in Table 18.

Table 18 Mean scores of roles played by poultry as reported in Kenyan Society (2006)

Role	Mean score (n=319)
Source of income	4.7
Home consumption (source of proteins)	4.0
Socio-cultural (gifts, honouring visitors, entertainment, aesthetics, waking up household members)	1.5
Source of manure	1.5
Source of cattle feed	0.9
Medicinal value	0.8
Other	0.4

Source: Kimani (2006)
NOTE: The higher the score, the more important is the role played.

Poultry also serve as gifts to friends and kin and in honouring important household guests. In Kwale District for instance, Njenga (2005) found that gifts and inheritance were an important source of initial stock of poultry flocks and ways of increasing the existing flocks (Table 19).

Table 19 Sources of local chickens in Kwale District, Kenya

Source (n=107 households)	Respondents (%)
1. Acquiring initial stock	
Purchase	75.5
Exchange	1.9
Inheritance	3.8
Gift	17.0
2. Increasing existing stock	
Breeding	70.8
Purchase	26.2
Gift	0.8
Inheritance	2.3

Source: Njenga (2005)
N= 107 households interviewed

Each Kenyan community has its own popular cuisine. Poultry products are occasionally used in local dishes. Eggs are consumed either alone or in wheat flour-based products such as cakes and bread. Table 20 presents the main dishes where poultry products are part of the ingredients.

Table 20 Special local dishes with poultry products as one of the main ingredients

Dish	Main ingredients	Community
Ingoho	Chicken meat served with Ugali	Luhya – mainly served to important visitors
Kuku	Chicken meat served with carbohydrates such as Ugali, chapatti or rice	All communities especially those in cosmopolitan areas
Kuku and *Nazi*	Chicken meat and coconut milk	Coastal communities
Chicken *tikka*	Chicken meat in garlic and tomato puree	Originally Indian cuisine but common in Kenya
Turkey	Turkey meat and accompaniments	Urban elite
Pan cake	Eggs and wheat flour	Most poultry-keeping communities

Source: Personal interviews

4.5 Gaps in knowledge

Although the village poultry production system has been studied (e.g. Njenga, 2005; Kimani, 2006), more studies are needed to enrich existing information and to provide a comparative perspective on aspects of poultry production in Kenya. Furthermore, these studies only concentrate on a few Districts of interest. A countrywide study could capture the social and economic differences that characterize the production system.

5. Review of poultry sector and bio security

The poultry sector is a very important sector in terms of its contribution to the peoples' livelihood and food security. The sector comprises different systems broadly divided into the commercial and subsistence indigenous/backyard sectors. The following sectors detail the different sub-systems in the two broad categories. There are various actors that are involved in the industry that include hatcheries, feed millers, transporters, abattoirs, slaughter houses, producers, whole sellers, retailers and animal health service providers (public and private) for different categories in the poultry value chain.

5.1 Breeding sub-system

These farms mainly keep the Grand Parent (GPS) and Parent Stock (PS). The GPS produces Day Old Chicks (DOC) for the PS which is sold to commercial hatcheries, both at the local as well as regional markets. The PS produces DOC for commercial layer and broiler production.

There are primary breeding companies in the country. Table 21 outlines the existence of breeding types in the country. Grand Parent and Parent Stock are probably present in Kenya, except for pure pedigree lines that are absent.

Table 21 Presence or absence of poultry breeding line in Kenya

	Present in country (yes/no)
Pedigree pure lines	No
Great grand parents	No
Grand parents	Yes, Broiler GPS at Kenchic
Parents	Yes
Layers	Yes
Broilers	Yes

Various commercial actors are involved in the poultry industry in Kenya. The different actors and their locations involved in the breeding sector are shown in Table 22.

Table 22 Commercial sector actors involved in poultry breeding in Kenya

Types	Breeds	Enterprises	Location of enterprises	Number of birds	Lifespan of birds
Parent stock	Arbor Acres Shavers , ISA brown, Ross, Hybro, Cobb, Hypeco, KenBro, Bovern	Kenchic Ltd Muguku 1 Muguku 2 Sigma, Kim's Kenbrid Bixa	Kajiado Kiambu, Ngong Nairobi, Nakuru, Naivasha, Mombasa	260, 000 N/A N/A 20,000 5,000 N/A N/A	Variable e.g. *Kenchic*: disposes after 1.5 years; *Muguku* after 6 months of laying *Kim's*-55-60 weeks; *Sigma* – 65 weeks for broilers&70 weeks for Layer Breeders
Hatchery	Arbor Acres Shavers , ISA brown, Ross, Hybro, Cobb, Hypeco, KenBro, Bovern	Kenchic Ltd Muguku1 Muguku 2 Sigma, Kim's Kenbrid Bixa Lakeside	Athi River Kikuyu, Ngong Nairobi, Nakuru, Naivasha, Mombasa Kisumu	286,000 DOC/wk 40,000 DOC/wk 80,000 DOC/wk 26,000 DOC/wk 14,000 DOC/wk N/A N/A N/A	N/A
Broiler production	Arbor Acres Hybro, Cobb, Hypeco	Contract farmers & Independent farmers	Through out, the country concentrated in: Thika, Nairobi, Kiambu Nakuru, Mombasa, Kisumu,	3.7 million	5-6 weeks
Layer production	Shavers , ISA brown, Ross, Bovern	Contract farmers and Independent farmers	Through out, the country concentrated in: Thika, Nairobi, Nakuru, Mombasa, Kisumu, Kiambu	2.41 Million	One year; farmers sometimes may induce a second laying cycle depending on the prevailing economic circumstances

Key
N/A Not applicable
Source: Mugambi (2007), Nyaga (2007)

5.1.1 Farms keeping Grand Parent Stock

(a) Type of birds and their population

Only one farm, the Kenchic Company Ltd, keeps the Grand Parent (GPS) and Parent Stock (PS) for broilers. Positioned upstream in the production chain, the farm serves as a foundation for a big proportion of the commercial broiler production in the country. The number of different category of birds raised at Kenchic birds is presented in Table 23.

Table 23 Population of different categories of birds at Kenchic farms

Type of Stock	Population at one given time
Grand Parent Stock (GPS)	6,000
Parent Stock (Broilers)	260, 000
Ken Chick broiler Farm (Athi River)	100, 000
Contract Farms	360,000
Hatchery	286,000 DOC produced per week

Source: Mugambi (2007), Nyaga (2007)

(b) Housing

Poultry housing at Kenchic is a modern open sided deep litter system. Houses are made of concrete floors with a layer of wood shavings as litter. The open part of the house is made of bird proof wire netting to keep out wild birds. The houses have nests from which eggs are collected, sorted, graded and packaged awaiting delivery to the hatchery. Feeding and watering is through an automated system. There are shower facilities at the main gate and before entering the houses.

(c) Biosecurity systems at Kenchic

According to the biosecurity assessment report by Mugambi (2007), the farm observes rigorous bio security measures to minimize the risks of incurring the disease. These include the control of entries that involves the following:

1. Entry into the breeder farms, hatchery and slaughterhouse is completely restricted. There is tight security at the main gate; one has to fill out a form showing his/her history (in terms of movement for the previous week) and heath status. If visitors have to enter the farms, the following conditions must be met:
   - That the visitor (including Kenchic staff) has not been in contact with poultry or the poultry processing industry for the last 7 days
   - Visitors are supposed to leave all their personal items in the car (which are parked outside the gate)
   - No vehicles are allowed into the farm except those that bring in inputs into the farm
   - Visitors must shower at least 3 times before entering the breeder farms and change into clean uniforms.
   - visit is restricted to one flock house per visit
   - Visitors must maintain a minimum distance of 30m from the Grand parents' unit internal fence
   - Visitors cannot visit clean areas (breeder farms) if they had previously visited dirty areas such as the slaughterhouse, hatchery or commercial farms; they can however visit the dirty areas after coming from clean areas.

2. Entry by workers and company staff
   - All workers must shower at least 2 times before entry into the farm and wear a clean staff uniform (they must shower again any time they go out the farm gate).
   - All the personnel in the farms, hatchery and slaughterhouses must wear protective clothing while working (head gear, gloves, overcoats, gumboots)
   - All vehicles entering the farms have to pass through a wheel bath and also be sprayed with disinfectant under pressure
   - Vehicles bringing in feeds are sealed from the factory to ensure no contamination during transit
   - The company encourages all workers to stay within the farms as much as possible. Workers who do this are given a token of Ksh 50 for each day they do not go out. The company prefers to employ men at the farm to minimize movement of children in and out of the farm.
3. Isolation is another biosecurity policy / measure that is adhered to in this sub-system and involves;
   - Kenchic breeder farms are located in Kajiado district along Nairobi - Kajiado road, is in a remote place located away from dense human settlements.
   - There are 4 breeder farms within a distance of about 12 km .
   - Within a given farm the grand parent units are located very far away from the parent houses
   - Workers in one poultry house can not move into another unit even within the same farm until at least 48 hours have passed.
   - To ensure that people living around the farms do not keep chickens, the company provides them with poultry products free of charge.
4. Sanitation is quite important in reference to biosecurity as it is very important in bio-exclusion at all times. The areas and issues of concern are detailed below.
   - There are foot dips with disinfectants at every entry point within the farm and in every poultry house; the disinfectant is changed three times a week
   - After eggs are collected, they are sanitized, graded and labelled; floored eggs are not used for hatching; workers have to sanitize their hands before collecting egg or any other egg handling.
   - A sanitary gap of 3 months is observed before bringing in new flock into a house
   - All the water tanks have lids to keep off wild birds
   - Drinking water is chlorinated to keep off pathogens such as *Escherichia coli*
   - Crates coming from the hatcheries can bring infection to the breeder farms. Thus, when they arrive at the farm's gate, they are soaked in a disinfectant overnight after which they are fumigated in a fumigation chamber. This is followed by disinfection with formalin. When they get to the farm, they are further fumigated before introduction into the houses.
   - At the hatchery, hatching eggs undergo a series of disinfection and fumigation before being put in the setting machines.
   - The company sources in feed pellet from only one company (Unga Feeds, Ltd); heat treatment during pelleting ensures that all pathogens are completely destroyed. In addition, feeds used by Kenchic and all its farms do not utilize ingredients of animal origin.
   - Any rejects of day old chicks are gassed and buried in pits. A pit for one cycle cannot be used during another cycle.
   - Hand sanitation points are available in the poultry houses, hatchery and slaughterhouse
5. Intrusions by other animals are potential sources of diseases and vectors to the enterprise. This then calls for the following conditions to be met as a protective measure. This includes the control of rodents, wild birds and other animals. The measures adhered to are outlined below.
   - Each poultry house is surrounded by a vegetation free distance of 3 meters to keep off rodents.
   - Liquid and solid baits are placed along the vegetation free strip during the dry and wet seasons respectively

- The grass is maintained short to keep away rodents
- There are baiting stations in which baits are covered by bales of hay to attract rodents.
- All poultry houses are made of rodent proof materials with bird proof wire used on the ventilations
- Electric perimeter fencing is used to keep off wild animals and other livestock

In addition to the biosecurity practices listed earlier, the following apply to the slaughter house which is also owned by the company. The following conditions are followed to avoid disease transmission.

- Complete delineation of the dirty and clean areas with restriction of workers from moving between the two;
- Batch slaughtering which ends up with a packaged product that bears that particular batch number to provide for traceability of the product up to the farm level;
- The liquid waste from the slaughterhouse is treated according to National Environment Monitoring Authority (NEMA) recommendations and deposited in a river; and
- All the solid waste is disposed of by a private company that has been contracted to do so.

(d) Animal Health practices and service provision

Information on routine poultry health practices at Kenchic is largely lacking in the available literature. DOCs are vaccinated against Mareks and Newcastle disease. Debeaking for laying flock is done at 14 weeks to stop cannibalism. Kenchic has an in-house veterinary service which attends to the birds on a regular basis.

(e) Sources of poultry

Kenchic is a franchise holder for Aviagen (the breeders of Arbor acres breed) in East and Central Africa; hence the GPS is imported from America. Other breeds include the Isa brown and the Bovers which are also imported. All the genetic material comes into the country as day old chicks. Whenever demand for DOC by commercial producers exceeds the supply, the company may opt to buy fertilized eggs, although this is very rare.

(f) Feeding

The company obtains all its poultry feeds from Unga feeds Ltd. The feed is normally in pelleted form and does not utilize animal products as feed ingredients. Unga tracks the transport of the feed which is usually sealed after loading until the time of offloading at the farms to prevent any adulterations during transit.

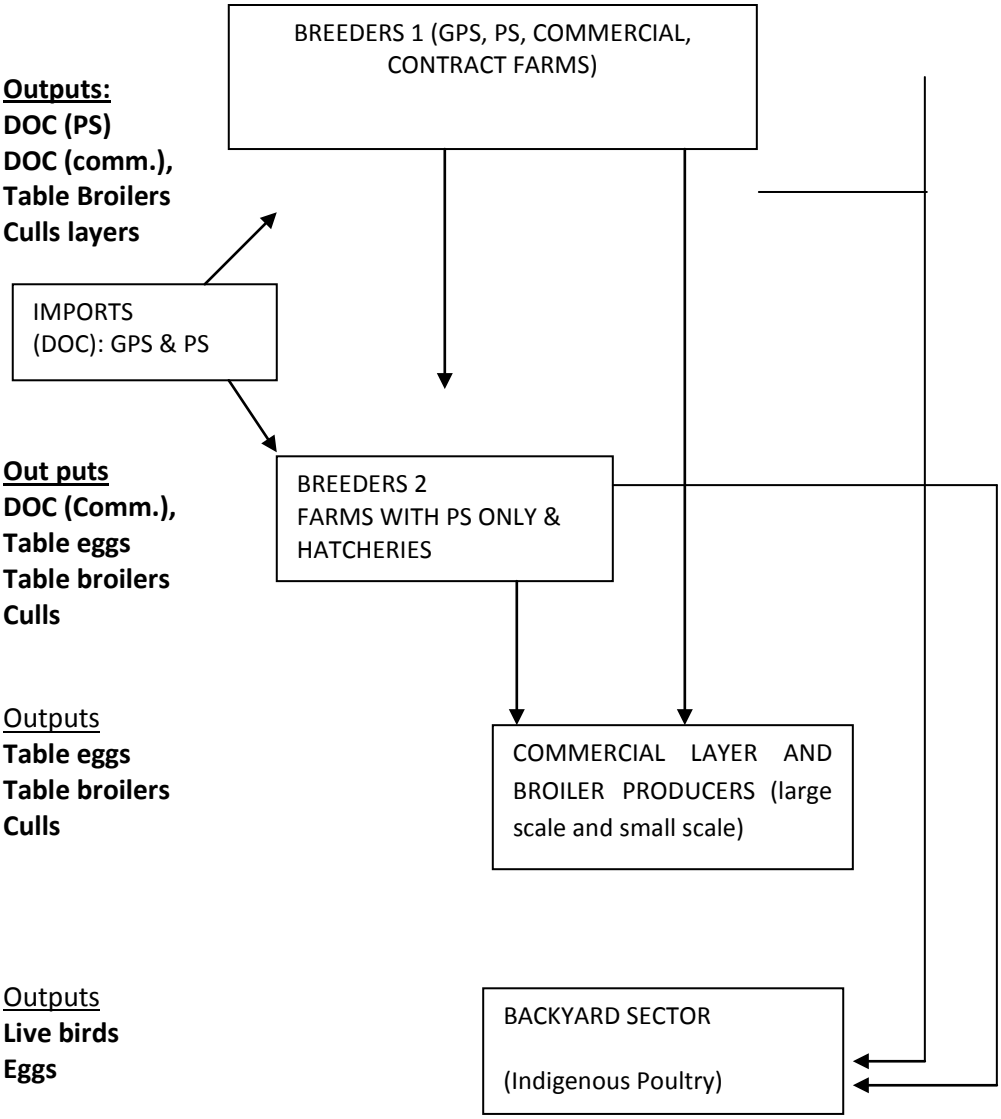
(g) Marketing

Day old chicks are produced at the hatchery located at Mlolongo which is about 40 Km from Nairobi. Approximately 60% of the DOC produced is sold to independent farmers and 40% sold to contract farmers. The company also exports DOC to other countries in the east African region. In the local markets, Kenchic has depots and agents in the main poultry producing towns such as Nakuru, Kisumu, Eldoret, Nyeri, Meru, Mombasa, and Thika.

(h) Vertical and horizontal integration with other players

Kenchic is 99% vertically integrated with 80% of its activities being on broiler production, processing and marketing. There are 7 breeder farms located along Nairobi Kajiado road. This is where the GPS and the PS are raised. Fertile eggs produced at the farms are delivered to the farm's hatchery located at Mlolongo, Athi River, where they are hatched. The company raises broilers through one of its broilers farms located at Mlolongo and others through the contract farmer system.

Figure 11 Interactions between the different players in the poultry production chain in Kenya



** Kenchic is currently producing a dual purpose breed (Ken Bro) which is mainly utilized in sector 4. Sector 4 also receives some of the reject cockerels (after sexing the layer chicks) from other hatcheries.

Source: Mugambi (2007)

The farms must conform to the standards set by the company as far as housing, biosecurity, and feeding is concerned (Mireri, 2002). Broilers from the contract farms and Kenchic farm are all slaughtered at the farm's modern export slaughterhouse in Limuru. Products are branded and marketed to other retail outlets. However the biggest proportion is sold through the company's fast foods franchise the 'Kenchic Inn. Figure 11 represents the interaction between these actor categories with other actors in the poultry production chain.

5.2 Farms rearing parent stock and hatcheries

5.2.1 Typical number of birds kept

In the Kenyan system, parents stock and hatcheries are usually integrated under one management system. Most of the farms are specialized poultry farms, hence no other livestock species are reared. Some farms, such Muguku, rear sheep on the compound in order to keep the grass short. Both broiler and layer day old chicks are produced and sold to the commercial farmers. Generally each of these farms (hatcheries) keep about 10,000-12,000 layer breeding stock and 10,000-18,000 broiler breeding flocks per year, producing about 300,000 to 800,000 day old layer chicks and 750,000 to 1.2 million day old broiler chicks per year (Nyaga, 2007a; MOLFD, 2004). Detailed information on the population, capacity, and DOC production from each of the farms/hatcheries is unavailable. There is also a possibility that there are some other farms in this category that are operational but not documented or others that may have ceased to be operational. Farms in this category include: Ideal Chicks (Sigma), Muguku Ngong, Muguku Kikuyu, Kim's Poultry Farm, Kenbrid, Bixa and Lake Chick Hatcheries.

5.2.2 Housing

Housing systems differs with farms, but there are some common features which have been documented. Generally, bird houses are of the open type; the rear and the bottom half of the front side walls are commonly made of stone wall. The open part (top half) is made of bird proof chicken wire mesh. Corrugated iron sheets are the common roofing material in all the farms in this category. The hatchery buildings are completely sealed except for the entry doors. They are ventilated by fans. Both the flock houses and the hatcheries have cemented floors

5.2.2 Bio security

Bio security assessment reports by Mugambi (2007) and Nyaga (2007a) show that biosecurity systems are variable in different farms, but generally the following practices are in place in Muguku, Sigma and Kim's poultry farm:

- Visitors are not allowed beyond the office; if visitors must go beyond the office, they must shower and wear gum boots and dust coats; Visitors who have visited poultry farms for the last 24 hours are not allowed;
- At the gate there are tyre dips and spray systems for vehicles; foot baths are also available;
- Upon reporting to the farms, workers must shower and put on clean uniforms;
- Routine cleaning and disinfection of equipment;
- Sanitary gaps of 3 weeks – 6 months;
- Separate workers and equipment for each unit;
- Rigorous cleaning, disinfection and fumigation of houses and equipment upon end of the cycle;
- Incinerators and burial pits are available to dispose of carcasses;
- Houses are bird proof; and

- Restricted entry and exit of materials/birds in and out of the premises.

5.2.3 Animal health service provision

There is no data on routine animal health practices in the farms that produce DOC for commercial farmers. Some of the farms in this category have in-house veterinary services while others outsource either from the government or private practitioners. However, the specific service providers for each of these players are not documented.

5.2.4 Where poultry are obtained

Parental Stock is usually imported as day old chicks from different countries depending on the breed of interest. For instance, Muguku imports DOC from France, UK and the Netherlands. Kim's poultry farm imports DOC for Rose breed from Zambia, and buys Arbor Acres from Kenchic Ltd. Bixa sources locally from Kenchic; Sigma imports from Holland, Germany, France and also sources locally from Kenchic (MOLFD, 2004). Fertile eggs may also be imported under certain circumstances, e.g. when the demand for the DOC from the commercial farmers is very high.

5.2.5 Feeding

Parent Stock is generally fed on concentrates in marsh form. Some farms, like Ideal Chicks-Sigma, opt to give their breeder flock pelleted feeds for the first 2 weeks of the chick's life. Sources of feeds depend on the farm's level of integration. For instance, Ideal Chicks-Sigma, Muguku -Kikuyu and Kim's poultry farm produce their own feeds for the flock. Most of the farms that do not mill their own feeds source feeds for the breeder flock from one company, Unga Feeds Ltd.

5.2.6 Marketing

Day Old Chicks from these farms are distributed throughout the country. Each of the farms has sales offices in major towns where there is a lot of poultry production. Muguku has direct offices in major towns, e.g. Nairobi, Thika, Mombasa, Mtwapa; Sigma has sales offices in Mombasa, Nairobi, and Athi River. These countrywide offices facilitate wide geographical coverage of products from different farms. Due to market competition, country wide distribution is further enhanced by presence of agents who reach farmers with products from specific farms. Some farms like, Sigma and Muguku, also export about 10% of the DOC produced to other east African countries—Uganda, Tanzania and Rwanda.

5.2.7 Vertical and horizontal integration with other players

This category is generally partially integrated rearing in which rearing of Parental Stock; hatchery activities and marketing are done within one farm. Some farms (e.g. Sigma, Muguku Kikuyu, Kim's) further integrate with feed milling. However, Kim's farm is fully vertically integrated; it is involved in rearing parent stock hatches and produces DOC which are sold to contract farmers (these farms are fully under management of Kim's farm). When broilers are ready, the contract farmers deliver them to the farm's slaughterhouse where they are slaughtered, packaged and marketed. Figure 1 presents horizontal integration of this category with other players in the poultry value chain.

5.3 Producers of commercial broilers and layers

Commercial production of broilers is undertaken by individual farmers, either as part of an integrated system or as sole producers and products marketers. Under contract terms, some broiler farmers are

integrated with breeders who provide them with inputs (DOC, veterinary and husbandry expertise, standards and in some cases feeds). After undertaking the production process, they (farmers) deliver the broilers to the processing plants, owned by the breeder company. A good example of this is Kenchic and Kim's contract farmer system. This system only works for broiler production.

Individual sole producers operate independently of breeders and other input suppliers and are responsible for product marketing. These farmers, who form the bulk of the commercial poultry farmers, are responsible for the product marketing process. There is no integration in the layer bird production in the country (Nyaga, 2007b). Due to significant differences within this actor category brought about by the resource endowments and the larger farming system dynamics, a description of this category, where necessary, will be done based on the scale of production; viz small and large scale commercial broiler and layer producers.

5.3.1 Typical species of livestock kept

Depending on the human settlement pattern and the farming systems, other livestock species are reared alongside poultry. In the very urban areas where farmers own plots, only poultry is reared. This, however, constitutes the smallest proportion of the commercial poultry producers. The bulk of producers raise different livestock species in order to maximize productivity per unit of land, to meet the market demands for livestock products as well as exploit the complementarities between different livestock enterprises. Major livestock species reared include: poultry, dairy cattle, pigs, sheep (mainly hair sheep) and goats (indigenous and dairy crosses).

5.**3.2** Typical types of birds kept

The dominant bird species reared for commercial purposes is the domestic chicken as broilers or layers. Commercial birds make up 28.6% of the national poultry population; broilers dominate the commercial birds industry with 20.1% while layers make up 8.5% (MOLFD, 2004). Other bird species reared under the commercial system include: ducks, turkeys, ostrich and guinea fowls.

5.3.3 Typical number of birds kept

The different categories kept in this sub-system are described below.

(a) Large scale producers (broilers and layers):

For broilers, large scale producers keep an average of 8,000 birds/HH with numbers ranging from 4,000-80,000 at one given time. An average of 5,000 layer birds/HH are reared with numbers ranging from 2,000-30,000 at one given time (Mugambi, 2007; Nyaga, 2007a; MOLDF, 2004). Large scale operators raise their birds in batches to ensure a continuous supply of marketable products throughout the year. These numbers are variable because of the seasonal patterns of poultry consumption, as populations are high during the festive seasonal.

(b) Small scale producers (broilers and layers)

Small scale producers rear an average of 800 and 500 birds per household for broilers and layers, respectively. The number of birds per household ranges from 300-2000 and 100-1,000 birds for broilers and layers, respectively (Mugambi, 2007; Nyaga, 2007; MOLDF, 2004). Numbers of small scale poultry farmers also fluctuate with market situations, which sometimes force some resource limited farmers out business.

(d) Commercial duck production

There are only two farms known to keep commercial ducks in the country: one is located in Naivasha while the other is located at the north coast. Both farms are vertically integrated, hence they undertake the hatching, rearing, slaughtering and processing. Available literature has not adequately covered commercial duck farming system, hence limiting further information on this category.

(e) Commercial turkey production

There is only one turkey farm in the country that specializes in broiler turkeys, the Nyonjoro Nightingale Farm. It is located in Naivasha on the slopes of a mountain range. The farm rears the birds from a day old, processes and markets the products as an independent system. About 10,000-25,000 birds are reared three times a year (Nyaga, 2007a).

(f) Commercial ostrich production

There are many farms licensed by the KWS to rear ostrich, but currently only the Maasai Ostrich farm in Kajiado is the most viable farm (EPZA, 2005; Nyaga, 2007a). Other licensed farms include: Ukunda Farm Park in Ukunda and Kedowa ostrich farm in Kericho. GEM's Poultry farm has a few ostrich, which the owner has not been able to exploit economically due to restriction in the marketing of ostrich products by KWS. The Maasai Ostrich farm hatches its own DOC from the farm's hatchery. Since the farm has its own feed mill, the birds are fed on feed made from within the farm. The birds nest in the open pens as they would in the wild environment. Eggs are collected, placed in the hatchery for incubation and the hatched chicks reared on the farm. Birds are slaughtered on site and any waste is disposed of by burial. The pens are usually fenced to keep out other large animals, although interactions with wild birds are uncontrolled. There is very little documented information available on commercial ostrich production in the country.

(g) Commercial guinea fowl production

GEM's poultry farm in the north coast is the only farm known to be keeping commercial guinea fowls. The birds are housed within reared runs made of wire mesh (Figure 12). The farm undertakes the hatching, rearing, processing and marketing of the products. The current information available has not adequately covered the guinea fowls; hence as in the case of ostrich and ducks, the guinea fowls have not been exhaustively covered in this review.

Figure 12 Commercial guinea fowl production in North Coast Kenya

5.3.4 Housing

Different types of housing are appropriately chosen depending on the scale and extent of production. The description is as follows.

(a) Layers and broilers under large scale operations

The deep litter system is the most dominant system, while a few farmers keep battery cages. The main litter used is sawdust simply because of its availability. The houses are made of solid walls at the rear, while the front side is halfway open. The main material for constructing the walls is either stone or timber, while the open side is covered with wire mesh. Because of the prevailing high temperatures in the coastal region, the poultry houses there are open on both sides. The floor is mainly made of concrete while corrugated iron sheets are the main roofing materials. The poultry premises are usually not fenced. These farms mainly use standard feeders and drinkers, especially those made of plastic, which are easy to clean.

(b) Layers and broilers under small scale operations

The housing system by the small scale operators is basically the same as of the large scale operators, except for the materials used. This category utilizes locally available materials such as wood planks, off cuts, corrugated iron sheets and mud to construct the walls. Deep litter is the main housing material, utilizing sawdust as the litter. Walls are made of off cuts, corrugated iron sheets and mud. Generally, the floor is usually earthen, as only a few farmers can afford to use concrete. The premises are usually not fenced. Feeding and drinking equipment are variable, some farms use the standard plastic types, but the *Jua kali* and improvised containers, made by cutting jerry cans into drinkers, are the most common.

(c) Housing system at the commercial turkey farm

At the turkey farm, the houses are roofed with corrugated iron sheets and the upper walls are made of wire netting. The lower part is made of iron sheets and the floors are cemented under the deep litter system. There is a free flow of air through the houses, except during brooding when sacking material is hung over the wire netting to preserve heat.

5.3.5 Biosecurity

The biosecurity systems in the commercial layers and broiler farms as described in the assessment reports by Mugambi (2007) and Nyaga, (2007a) are as follows:

Biosecurity systems in place in the large scale broiler and layer farms are as detailed below.

- Presence of foot and wheel baths with disinfectant at the gate for vehicles and feet; each and every entrance and doors to the poultry houses has disinfection points
- Some farms restrict entry of visitors into the farm
- Workers are provided with gum boots and overalls for use in poultry houses and slaughterhouse;
- All dead chicken are buried in pits within the farms
- For farms with their own slaughterhouses, there are septic tanks available for liquid waste from the slaughterhouse. After slaughtering is complete, the houses are washed and disinfected, with the liquid ultimately flowing into the septic tank
- Farms with different species (GEM's farm) have separate workers for specific species, slaughterhouses, breeding stock and hatchery
- Vaccination programmes in place for common poultry diseases
- All in all out management system
- Contact with wild birds completely controlled
- Contact with other domestic birds completely controlled
- Free entry of material/ birds to premises completely controlled
- Free exit of materials /birds from premises completely controlled

Biosecurity systems in place in the small scale broiler and layer farms are as follows.

- Vaccination programmes in place for common poultry diseases
- All in all out management system
- Contact with wild birds completely controlled
- Contact with other domestic birds completely controlled; however few farms keep free ranging indigenous chicken, ducks, turkeys and geese
- Free entry of materials/birds to premises not completely controlled
- Free exit of materials/birds from premises not completely controlled

Biosecurity systems in place in the Turkey farm are as follows:

- There is a disinfectant dip at the gate through which vehicles entering the farm are decontaminated. No facility for disinfection for human traffic exists.
- Utensils and other rearing equipment are kept in the open air outside the turkey houses just as they had been used by birds without being cleaned, as seen during the visit to the farm during the study period.
- Solitary location of the farm in the forest on the slopes of a hill was intended to be a good bio-security measure since there would be less human traffic to the farm and the forest would act as a biosecurity wall.
- Waste from the slaughtering process, including the feathers, is buried within the farm.

- The farm uses a very effective disinfectant for decontaminating the hatchery and flock house operations and they observe strict vetting of persons entering the farm.
- In case of an Avian Influenza outbreak decontamination and disposal of birds by burial or burning can be carried out comfortably on the farm since the farm is large and secluded from other poultry farms.

5.3.6 Animal health practices and service provision

Commercial layer and broiler farmers have vaccination schedules for common poultry diseases. These include: ND, Fowl typhoid, Gumboro and Fowl pox. Other routine health management practices include deworming and the provision of supplements. However, the age and frequency of vaccinations and deworming are not documented. Generally, commercial layer and broiler farmers do not have in-house veterinary services. They rely either on the government or the private practitioners whom they engage whenever the need arises. Small scale producers mainly buy drugs from the agro vet shops to whom they describe the animal condition and in turn receive a prescription. The role of different animal health service providers in the commercial layer and broiler production remains largely undocumented.

5.3.7 Source of poultry

Poultry is sourced from different places depending on the scale of production. The sources are described in the following sections.

(a) Commercial layers and broilers

- Commercial layer and broiler production source their genetic material from two main sources. These include:
    - On farm breeding is done by some commercial farms that own their own hatcheries. These buy DOC for Parental Stock from main hatcheries, such as Kenchic. Birds are reared and slaughtered within the farm. Marketing is done by the farmer and farm vehicles are mainly used for transportation. Though there is no documented evidence, the proportion of farmers doing on farm breeding is very small (usually below 10%).
    - Bought into the farm: Over 90% of commercial farmers use this approach. Chicks are bought at day old form main hatcheries and reared until they are ready for market (broilers) or throughout the production cycle. The main hatcheries are located in close proximity to high commercial poultry production areas, i.e. Nairobi, Kiambu, Nakuru, Athi River, Mombasa and Naivasha. To meet the market demands, Kenchic has a subsidiary hatchery located in Mombasa. Since commercial poultry farming is done in most parts of the country, except North Eastern Province, DOCs are transported on land from the production foci through hundreds of kilometres to meet the market demands throughout the country. Kenchic, Sigma and Muguku have their chicks distributed throughout the country, while Kenbrid. Bixa and Kim's are localized within their regions. Depending on the scale of operations, some farmers receive the DOCs directly from the hatcheries or through the agents for small scale operators. Some are also distributed through the Agro-vets. Depending on the numbers of birds involved, and therefore the economics of transportation, the DOC can either be transported in pickups specifically for that purpose or personal vehicles and for small scale vehicles through public transport. All DOCs are transported in fully ventilated cartons.

(b) Turkeys

The breeding stock for the turkey farm is usually imported from the United Kingdom. The farm imports day old chicks which are reared, slaughtered and marketed by the same farm.

5.3.8 Feeding

Feeding of poultry depend on the type of production, ability of the farmer and scale of production as described in the following section.

(a) Commercial layers and broilers

Commercial layers and broilers are exclusively fed on concentrates mainly in the form of mashes. Though data on actual proportions is unavailable, only a few poultry farmers formulate and mill their own feeds due to limitations by the economies of scale and the lack of technical capacity to balance the rations for optimal poultry production. The majority of farmers purchase feeds from commercial feed millers distributed throughout the country. Kenya's feed industry is not specialized on any one type of feed or for specific livestock species, but rather produces a wide range of animal feeds. This explains the wide distribution of feed millers as shown Table 2. However, it is notable that poultry feed millers are concentrated in the high commercial poultry production areas, especially Nairobi, Thika, Kiambu and Nakuru (Table 24). Due to rigorous marketing, farmer preference and the perceived feed quality, feed consumption is not localized; hence, feed millers transport their feeds from one geographical region to another. Feed gets to farmers through the input suppliers stores, commonly referred to as agro vets. Where agro vets are located far away from farmers, there are middlemen who stock feed shops for farmers around a given locality. Large scale farmers buy feeds in bulk, and depending on locality, can buy directly from the millers who provide the means of transport. Small scale farmers, however, do not buy and store, but buy as they use, transporting mainly with wheelbarrows. Different feed categories in the market include chick mash, broiler starter broiler finisher, grower's mash, layers mash and duck mash.

Table 24 Main poultry feed millers and their location in the country

Town	Miller
Bungoma	Sangalo millers
Eldoret	Arkay feeds
Eldoret	Agrivet Millers
Kericho	Kapsoit Millers
Kiambu	Tigoni Mahiu Feeds
Kikuyu	Ngecha feeds
Kisumu	Lake feeds
Kisumu	Millennium feeds
Kisumu	United Millers
Kitale	Faida feeds
Limuru	Tigoni Mahiu Feeds
Maragua	Will feeds
Maragwa	Wawa Feeds
Meru	Meru Central, Union
Mombasa	Atta millers
Mombasa	Kisumuwalla
Mombasa	Diamond feeds
Mombasa	Pwani feeds
Mombasa	Kibos Industries
Muranga	Maragua Feeds
Nairobi	Belfast Millers
Nairobi	Care vet
Nairobi	Dandora Millers
Nairobi (Industrial)	Farm feeds
Nairobi	Farmers Choice
Nairobi	Finn feeds
Nairobi (Kariobangi)	Hemco feeds
Nairobi	Pembe feeds
Nairobi	Premium Feeds
Nairobi	Ruaraka Feeds
Nairobi	Sigma feeds
Nairobi	Superior Feeds
Nairobi	Tam feeds
Nairobi, Nakuru, Kisumu	Unga feeds
Nairobi	Waroro feeds
Nakuru	Lens feeds
Nakuru	ABC Feeds
Nakuru	Anifema feeds
Nakuru	Modern feeds
Nakuru	Rift feeds
Nakuru	Equator feeds
Ruiru	Treasure feeds
Sagana	Midland Millers
Thika	Muus
Thika	Njuca feeds
Thika	Jubilee feeds
Thika	Champion feeds
Thika	Mayfeeds
Thika	Mutu Feeds
Thika	Chania Feeds
Thika	Wama Feeds

5.3.9 Marketing and other uses of commercial poultry and poultry products

Main poultry products from the commercial broiler and layer production systems are table broilers, eggs and spent layers.

Manure is a very useful by product from commercial systems. All products from this actor category (except for manure) are solely for a commercial purpose, hence very little is put to other uses. However, information on these utilization patterns is lacking from the available literature. Seasonality in market availability is experienced by both small and large scale actors. Markets are good during festive seasons, such as Christmas, and peak tourist seasons.

(a) Table eggs and broilers from the small scale producers

Small scale broiler farmers with a few birds may slaughter them on their own, whereas when 100 or more birds are involved, the farmer would usually call traders from the city market who come and do the slaughtering (Blum, 2008). The farmers may also recruit other people to do the home slaughter. The main market outlets for broilers from small scale producers are: local hotels, direct consumers, municipal markets, institutions and hospitals. Middlemen are involved except in the link between the producers and direct consumers, which is a very insignificant outlet in the chain. The marketing of eggs incurs more movement from one part of the country to the other, e.g. eggs from Thika in Central province are sold in almost all the provinces in the country. Eggs are also sold through middlemen system in each location to reach distant traders, or directly sold to consumers, hotels, supermarkets and institutions. Spent layers are usually sold to middlemen who may decide to slaughter the birds at the home of the farmers or take the spent hens to the live bird markets for sale.

Eggs from small scale actors are often sold to the middlemen who have orders from hotels, local shops, kiosks and local hotels. To take advantage of the economies of scale, small scale layer producers, especially from central province, have egg marketing groups who assemble and transport eggs to distant markets. Small scale layer producers also sell through their input suppliers (especially feeds); they buy feeds from the suppliers and the suppliers in turn will buy and market the eggs

(b) Table broilers and eggs from large scale producers

The main outlets are the large hotels, both in local and distant towns. The role of the middleman is very minimal as most of this player category is under contract terms with the target markets. For broilers, these farms have their own slaughterhouses where they slaughter and package their products for markets. Eggs from this category are also sold directly to the target markets, and in some cases to other traders.

(c) Turkey farm

Birds are slaughtered when they reach either 4 or 11 kg dressed, depending on the market demands. The dressed turkeys are sold on a contract basis to Farmers Choice (80%) and Kenchic (20%) meat processors who then process them further, package and sell the final products to target markets in supermarkets and hotels (Nyaga, 2007a).

5.4 Backyard poultry production

5.4.1 Typical species of poultry kept

Back yard poultry production is based on indigenous chickens and forms an integral component of the whole farming system. Birds in this system are kept for various uses and are present wherever there are humans (both rural and urban areas). The greatest proportion of these is, however, in the rural areas where they are reared under the scavenging feeding system. It is estimated that over 90% of rural households keep indigenous chickens (Nyange, 2000; Ndegwa, 2000). As components of mixed farming systems, they are reared alongside other livestock species. These include cattle (dairy and beef), pigs, sheep, goats, rabbits, camels and donkeys. The specie mix depends on the agro ecological zones.

5.4.2 Typical types of birds kept

Generally, the backyard system involves multi-species and multi-age rearing of birds. The common species reared include domestic fowl, ducks, geese, turkeys, quails and pheasants.

(a) Indigenous chicken

Indigenous chickens constitute an estimated 76% of the total poultry in the country, which translates to 21.6 million birds (MOLFD, 2004). The average flock size is 16-20 in the rural areas and 17 birds per household in the peri urban areas, as revealed in different studies around the country (e.g., Okuthe and Buyu, (in press); Njenga, 2005 and Okuthe, 1999). Indigenous chicken flock sizes lie in the extreme ranges of 5 to 500 birds per household, depending on the objectives. A study at the coast revealed that viable flocks of over 50 birds are kept by poor households. The flock sizes, however, vary from season to season depending on feed availability, disease incidences, prevailing economic circumstances of the households and other environmental conditions. The number and distribution of the indigenous birds are highly influenced by the social, cultural, economic and biophysical environment. For instance:

- There is an inverse relationship between human population density and the poultry population. Hence, there is a higher population of birds in the lower agricultural potential areas due to two main reasons:
    - Land use pattern and its linkage to poverty levels: As the agricultural potential diminishes in the lower zones, poverty levels increase as farmers do not have the capacity to increase productivity from these areas. Poultry, therefore, becomes very important for enhanced household food security and incomes in such places because of their low capital requirements. Furthermore, land, which is a major limiting factor of production, is not a constraint in these zones.
    - The hot climate in the lower zones favours faster growth of chicken than in the higher zones. The cool climate in the higher zones is also associated with disease outbreaks, especially the ND.
- Social and cultural factors: In Western Kenya, domestic consumption of chicken is highly valued and very important for welcoming visitors, especially at social functions such as funerals. As such, the chicken population per household is apparently higher than the national average (29 birds per household) but has not grown appreciably due to high consumption (Mugambi, 2007). In addition, there is the biggest diversity of poultry species. In other areas such as Bomet, many farmers derive their livelihood through the sale of chicken and eggs. It is argued that two eggs may not be adequate for the whole family, but if sold they can be sufficient to meet the cost of

producing a maize meal from a posho mill; this has led to the increased population of birds for household income (average of 21). The population of indigenous chicken in the rural areas is smallest among the Maasai community because traditionally they were not poultry eaters; this practice is however changing with time.

- In areas where there has been interventions in the form of projects on poultry, the average number of birds per households is as high (e.g. in this study the Kilifi district), which has had a DANIDA funded project promoting Indigenous chicken had an average of 23 birds per household. The Makueni district, which has just benefited from the ABD project, had an average of 19 birds per household (this is still above the national average of 10). Individual farmers within the groups that have benefited from the project interventions in Makueni have an average of 40 birds per household, an effect that is expected to spill over in the whole district with time.

(b) Indigenous turkey and duck flocks

In many homes in the Peri-urban areas of Nairobi City and in the rural homes of Central, Nyanza, Coast and Eastern, there are households with 2 to 6 turkeys. A similar number of ducks may also be kept. However, there are more ducks in the informal settlements in the urban areas. In low income areas, ducks, turkeys, and geese are mainly kept for economic reasons, while in the high income areas they are kept for prestige and hobbies along with other pet birds. The turkeys are kept in mixed flocks with chicken or together with chicken and ducks. It is estimated that 30,000 turkeys were kept annually from 2001 to 2006 (Nyaga, 2007a).

5.4.3 Housing

The housing system for backyard poultry is highly variable with improvements occurring along different social, cultural and economic perspectives. There is a general consensus among authors of the description of poultry housing under the backyard system (e.g. Blum, 2008; Nyaga, 2007a; Mugambi, 2007; Njenga, 2005; Kaudia and Kitalyi, 2000). However, on the other hand, some farmers have no poultry houses at all and birds sleep outside on trees. In most areas of Kenya, indigenous chickens are kept in a separate house that is located very close to the main house for security purposes. In some other communities, the chickens are kept in the family house during the night. An improvement of this is seen in some communities in the rural areas as well as the slums, where a woven basket is used for covering chicken in the night to confine them to one part of the house. Where housing is provided, the houses are elevated above ground and have floors and walls made of wood planks and roofs made of thatched grass. Some more advanced houses may have iron sheets for the roofs. In other places, the houses are not elevated and the floor is made of dirt with mud walls and thatched roofs. Some of the elevated houses are made of intertwined thin sticks for the flooring and walls. They are usually elevated a meter or so above the ground to avoid predators. Other chicken houses are made by simply surrounding the lower part of the granary with chicken wire, leaving a door for the chicken to enter. Most of the chicken houses described here have doors that are so small that at times only young children are able to enter. It is difficult for the adults to clean these houses.

5.4.4 Biosecurity

The biosecurity level in the backyard sector is very low. The free range system allows interaction between domestic and wild birds, birds and other domestic animals as well as multi-species and multi-age rearing. There is a mixing of birds within neighbourhoods as fencing between farms is

uncommon. Vaccination, one of the effective disease control methods, is done by very few farmers, especially in areas where there are donor funded projects.

(a) Animal Health Practices

There is no regular disease control regime in this production system. Studies have shown that ND, salmonellosis and Helminthiosis are important diseases in the backyard system, but farmers do not implement any control measures such as vaccination or deworming (Njue, 2002a ; Njue, 2002b). Studies carried out reveal that farmers use herbal treatments such as red pepper, Neem and fresh leaves from *Aloe spp* .In addition, there is substantial application of self administered drugs and pesticides, e.g. aspirins, piritons, capsule antibiotics for human treatments and use of poisonous chemicals like malathion and Power tab for ectoparasite control (Mathuva, 2005, Njue, 2001). Though vaccinations are available in the country, backyard chicken farmers do not utilize them partly due to lack of awareness, unavailability of vaccines in rural areas, large quantities of vaccine per vial which do not commensurate with the small flocks and lack of cold chains (MOLFD, 2004).

5.4.5 Poultry health service providers

A wide range of service providers are available for farmers in the backyard production system. These include Agro vet operators, animal health assistants, community animal health workers, government extension staff and private and government veterinarians. The roles of these people and their frequency of interaction with farmers have not been studied.

5.4.6 Sources of poultry

The major flock increment is through random breeding and hatching of a farmer's own chicks without buying chicks, pullets and cockerels from a hatchery or any poultry industry. Nesting boxes are prepared using cheap local materials. Systems are improved with grass bedding, wood shavings or straws are placed in the nest box to protect eggs from getting broken and to provide warmth. The introduction of breeding animals into the farm through gifts is also common, but the exact proportions are not documented. When animals are brought in as gifts, there is usually a movement of birds within the villages and also from one geographical region to another. A big proportion of birds for rearing are also sourced from live bird markets within the same locality.

5.4.7 Feeding

Birds scavenge for feed in their home environment as well as within their neighbourhood. They are also fed excess food from the home or are given supplementary feed like maize, grains, cassava, sweet potatoes or commercial feed, although very few farmers can afford this source of feed (Kaudia and Kitalyi, 2000). Supplementation also depends on the availability of the feedstuff relative to the human food abundance. Ducks in the slums wade in open drainage and sewer systems, thus making them more preferred in such areas (Blum, 2008).

5.4.8 Marketing and other uses of poultry and poultry products

The main products from this system are live birds and eggs. Only 10% and 40% of eggs and poultry meat produced from the backyard poultry production system are marketed (Njue, 2001). There is no organized marketing system for poultry and poultry products from this system. However, some marketing hierarchy exists. It involves the bulking of birds from farmers by village based collectors through a series of middlemen up to traders in a distant market who act as distributors to

consumers, retailers, and institutions. Farmers may also sell directly to neighbours, local kiosks and butcheries. Since this is not a commercialized system, farmers mainly sell their products as the need for cash arises, hence actual percentages/proportions of birds sold or consumed per household have not been established. There is seasonality in the supply of birds to the markets. For instance, soon after the outbreak of a disease, it takes time for farmers to build their flocks again, hence low supply to the markets (Mugambi, 2007).

Live birds markets are either formal or informal. Informal markets, which operate with small numbers of birds targeting direct consumers, are mainly found in urban, peri-urban areas and on road sides. Formal markets, on the other hand, involve a large number of birds traded and are recognized by the respective city, municipal and county councils. Another notable characteristic of indigenous poultry marketing is the geographical distance through which live birds are moved from one locality to another For instance, birds in the Nairobi markets come from Bomet, Kericho, Makueni, Machakos, Mwingi and Kitui while the Mombasa market is fed by the Makueni, Machakos, Mwingi, Kitui and Kwale districts.

The use of slaughterhouses in the marketing of indigenous chicken is a new approach that has been necessitated by emerging poultry diseases and the need to add value to poultry products. Farmers and middlemen supply live birds to slaughterhouses where they are inspected, dressed and packaged for markets. This is done according to the market demands. In some areas, especially those with Muslim consumers, the use of slaughterhouses is gaining more relevance by providing an opportunity for buying chickens that have been slaughtered according to the Islamic requirement of cutting the neck by a Muslim *(Halal)*. Table 25 lists poultry slaughterhouses in the country.

Table 25 List of slaughterhouses and their location

Slaughterhouse	Location
Thika	Thika town
Kariokor	Nairobi
Majengo	Mombasa
MacKinnon	Mombasa
Makueni styles	Wote, Makueni District
Sultan Hamud	Makueni district
Nakuru	Nakuru Town

Source Mugambi 2008

5.4.9 Vertical and horizontal integration with other actors

This is a completely non - integrated system and all players act independently.

5.5 Support service actors

These actors are very important for the sustenance of the poultry industry, hence the need for the detailed description in the following sections.

5.5.1 Feed mills and feed transporters

Though commercial feed millers are distributed all over the country, they tend to be concentrated in major towns and cities for ease of access of raw materials and also to be in close proximity to the commercial livestock producers. The highest percentage of concentrate feed produced in the country are poultry feeds (56%). The ingredients used are mainly those imported, except for the energy

source which is locally produced maize and its milling by-products (MOLFD, 2004). Due to shortages of protein sources in the country, protein based ingredients such as sunflower/cotton seed cakes are usually imported from the East Africa region. Premixes are also imported from Switzerland and Israel.

Feed millers are either fully commercial, in which they produce and market their feeds, or owned by poultry producing farms such that all feed produced is used within the farms. Commercial feed millers are the majority as they produce feeds for all other livestock species. Muguku, Sigma, Hedge farm and Kim's are examples of poultry farms producing their own feeds, hence constituting a semi vertically integrated system. All farms producing GPS and PS source specialized feeds from one company, the Unga Feeds Limited. Some small scale commercial farmers groups have ventured into milling feeds for their own birds and also to sell to non members.

Feed milling companies produce as well as transport feeds to the consumers through retail outlets such as agro vets. Very little literature is available on the biosecurity practices at the feed mills in the country.

5.5.2 Poultry slaughterhouses

Below is a detailed description of the poultry slaughterhouses in the country as described in the biosecurity assessment reports by Mugambi (2007) and Nyaga, (2007a). There are 2 categories of slaughterhouses i.e. privately owned slaughterhouses and slaughterhouses owned by city or municipal councils (public slaughterhouses) that are detailed in the following sections.

(a) Private slaughterhouses

Some private slaughterhouses are a component of the poultry farms, especially the large scale broiler farms. These are used for slaughtering broilers from the farm only. The scale of operations and sophistication for private slaughterhouses are variable, ranging from the export slaughterhouses owned by Kenchic to simple slaughterhouses owned by individual farmers. Kenchic owns a modern export processing plant in Limuru for slaughtering, packaging and marketing of broilers from the farms. The company has fast food franchises in major cities through which most of the products are marketed. Some products are also branded and sold to other retail outlets and butcheries. Kim's Poultry farm also has a similar slaughterhouse for processing broilers from the contract farmers. Kim's poultry farm processes products for Farmers' Choice, who undertake the product marketing.

Main market outlets for broilers slaughtered from individual farms are big hotels in the cities. All private slaughterhouses have employees attached to plants. Services such as cleaning and sanitation, waste disposal and general maintenance are therefore the sole responsibility of the business owner

There are two privately owned slaughterhouses located in the former Makueni district (Makueni styles and the Sultan Hamud slaughterhouse) that mainly utilize indigenous chicken only. They, buy birds either from individual farmers, farmer groups or traders and slaughter, package and market the meat. Main market outlets for these slaughterhouses are individual consumers (smallest proportion), hotels (local and distant), supermarkets (local and distant) and municipal markets. The marketing of products from these two slaughterhouses is detailed in Table 26.

(b) Municipal and city councils slaughterhouses

Slaughterhouses in this category include the Thika poultry slaughterhouse, MacKinnon Market in Mombasa, Majengo Slaughter houses and Kariokor markets in Nairobi. These are located in cities and towns and are usually attached to terminal markets which receive live birds from up country. The municipal or city council has the full responsibility of providing basic services to the markets such as cleaning and sanitation, disposal of solid and liquid waste and general maintenance. Slaughtering is done by people hired by the bird owners and payment is based on the number of birds slaughtered

Table 26 Main market outlets for private slaughterhouses in Makueni

Slaughterhouse	**Market outlets**
Makueni styles	(1) City market in Nairobi – 300 pieces per week (2) Naivasha supermarkets in Machakos - 100 per week (3) Ikuuni Hotel in Machakos-180 per week (4) Heritage Hotel in Machakos- 100 per week (5) Local hotels in Wote and Individuals – 300 per week
Sultan Hamud Slaughterhouse	(1) These are branded and marketed by one marketing company called "farm to plate". Distributed as follows: (a) Wool Matt in Nairobi (b) Naivasha stores in Machakos (2) Non- branded are sold to City Market in Nairobi and local hotels.

(c) Biosecurity Issues in the Slaughterhouses

Biosecurity practices in the privately owned slaughterhouses are described below.

- Complete delineation of the dirty and clean areas with restriction of workers from moving between the two
- Batch slaughtering which ends up with a packaged product that bears that particular batch number to provide for traceability of the product up to the farm level.
- Thorough cleaning and disinfection of all surfaces
- Enhanced use of protective clothing
- In the large scale processing plants, inspection of birds before slaughter and meat after slaughter is done by farms' inspectors with regular inspection of facilities by the personnel from the department of veterinary services. For individual farmers, the personnel from the department of veterinary services are involved in the inspection.

(d) Biosecurity practices in the slaughterhouses for indigenous chicken

- In the privately owned slaughterhouses, there are septic tanks to which the liquid waste is drained. There are also condemnation pits which feathers and any condemned carcasses are burned.
- In the public slaughterhouses, the liquid waste is usually drained into the main sewer system.
- Wearing of protective clothing: generally people handling chicken wear an over coat and gum boots.
- Inspection of birds before slaughter and meat after slaughter is done by personnel from the department of veterinary services and the necessary documents are issued
- Unlike the others, Mombasa and Makueni Slaughterhouses have clearly separated clean and dirty areas. However, in all there is no control of workers and other personnel between the

two areas. Personal items were also seen all over the slaughterhouses and the terminal bird markets.

5.6 Informal sector chicken and egg traders

This is a very important sector. It has different categories and actors that are described in the following section.

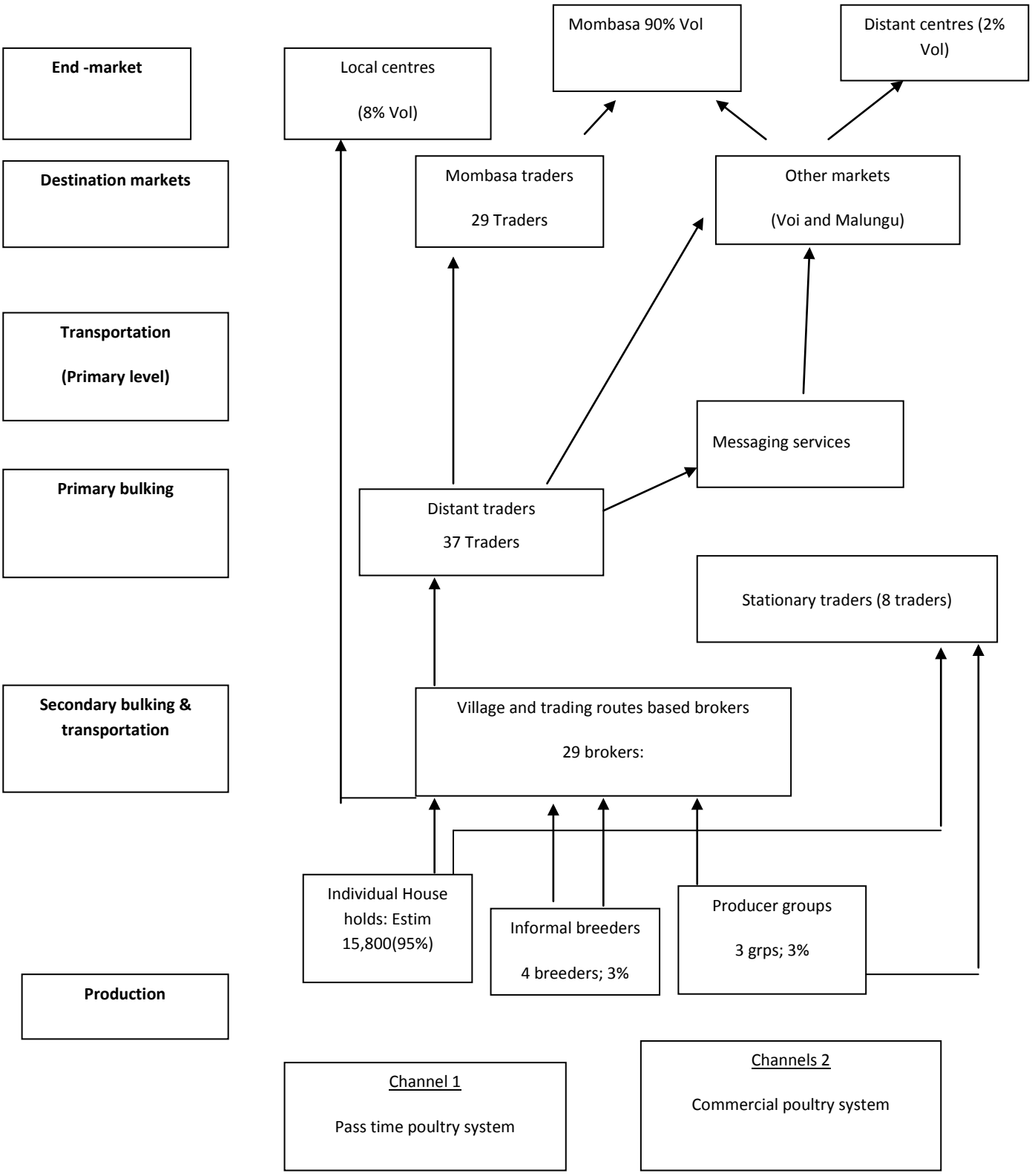
5.6.1 Informal sector chicken sellers

The marketing system for eggs and live bird is more or less similar, but differs between the commercial and the backyard systems. The main actors in egg trade (indigenous chicken) are:

- Producers who sell at the farm gate either to traders, Kiosks or local markets, and
- Middlemen who buy in bulk from farmers and either sell directly to consumers or sell to hotels and distant traders. Generally, there are different levels of middlemen in the poultry trade that are village based collectors: bulks who buy birds in bulk from farm to farm and take them to the market, mostly selling to the market based distant traders; market based brokers who buy from farmers bringing into the markets and sell to market based distant traders; distant market traders based at the market, who are linked to traders from distant towns such as Nairobi, Nakuru, Mombasa, Eldoret, Kisumu; and traders based at the terminal markets that receive birds from traders bringing chicken from upcountry. They mainly retail to consumers, sell to other traders who are stationed in city kiosks or sell to specific hotels.

Figure 13 presents a poultry sub sector map developed from a study in the Kilifi and Kwale districts of the coastal region. The map also indicates the representation of various actors and their numbers. Results from this study also showed that 95% of birds from this system reach the distant markets through brokers. The chicken sellers involved in the trade of broilers and spent layers have the same type of players. However, documented information on their relative proportions is largely lacking.

Figure 13 Indigenous poultry sub sector map for Kilifi and Kwale districts, coast province



Source: Mathuva, 2005

5.6.2 Informal sector egg sellers

Main players in selling of eggs are the producers: farmers normally sell at farm gate, kiosks: farmers who do not sell to middlemen sell to kiosk operators who retail to consumers, middlemen who bulk eggs from individual farmers and sell to distant traders and buy eggs from source markets in one region and goes to sell as wholesalers in another market, terminal market based traders/wholesalers and hotel operators.

While this is the general flow of egg products from the producers to consumers, there is a scarcity of information on the proportion of different players and the market governance at large.

5.6.7 Important players

Different players usually exchange information through various interactions. The frequency of interaction also differs depending on the type of production system and the level of trust, as shown in Table 27.

Table 27 Matrix showing interaction between different groups of actors

	Number	**Location**	**Integrated (linked to production)**	**Through put (birds per year)**
Feed mills	52 registered millers	33% around Thika, Nairobi & Kiambu; 13% Nakuru ;the rest are distributed throughout the country	<10% of the millers linked to production, exact figure not documented	NI*
Feed transport	Done by the millers, no specialized transporters	NA*	NA*	NA*
Transport day old chicks	Done by the hatcheries, no specialized transporters			
Firms transporting eggs	Not available			
Transport broilers and spent layers to abattoirs	Transported by producers/live bird traders			
Egg packing plant	Not available			
Meat processing plant	3	Farmers' Choice (Nairobi),	Not integrated	NI
Abattoirs		(Kenchic)Limuru Nakuru Naivasha Nairobi Mombasa, Thika Makueni	Kenchic &, Kim's are over 90% integrated; Mombasa ,Nakuru, Nairobi & Thika are attached to live bird markets; Makueni not integrated	NI
Poultry vaccine producers	1	Kabete	Not integrated	NI
Specialized poultry vets	Not available	NA		

Key

a) Exchange of poultry/inputs, outputs from column to row (P1 high, P2 medium P3 low)
b) Exchange of information from column to row (I1=high, I2= medium, I3= low)
c) Level of trust (T1=high, T2=medium, T=3low)
d) Frequency of interaction: daily, weekly, monthly, less than monthly, never

Note the matrix reads FROM column TO row i.e. the level of exchange of material, information and trust from one system to another.

NA: Player category does not exist in the Kenyan systems, options such as the hatcheries delivering to farms (depending on quantity, use of personal vehicles and public service vehicles)

The existence or stability/continuity of different systems and actors over a period of time and space are shown in Table 28. The general trend indicates that there is a general increase for all the production systems and support services.

Table 28 Stability (continuity) of each actor over time and space

		Present	**Numerical trend**	**Location**	**Geographic trend**
Commercial	Layers	Over 30 years	Up	Urban and Peri-urban	Increasing
	Broiler	Over years	Up	Urban and Peri –urban	Increasing
Backyard	Chicken	Always	Up	All	Increasing
	Ducks	Always	Up	All	Increasing
Support services	Feed mill	Over3 0 years	Up	Peri-urban	Increasing
	Transport day old	Over 30 years	Up	All	Increasing

5.7 Production systems and biosecurity

Vaccination teams that cover more than one farm and that do not disinfect thoroughly between the premises are a problem in the country. In the backyard system, farmers who are willing to vaccinate their birds assemble their birds at one place where they invite a service provider (from the government or private sector) to undertake the vaccination. Small scale commercial farmers vaccinate for themselves for some diseases. Large scale commercial farms use in-house vaccination teams, but backyard flocks are vaccinated by government veterinary services. There is no data on vaccination coverage in the backyard system (in numbers and geographical reach). Data on the proportion of the cases is also not available.

Vehicles, containers and catching teams used to transport birds to production units not cleaned and sanitized before and after visits are also major problems in Kenya. There is no system in place for the transportation of DOC from hatcheries to commercial farms. Convenient options are utilized, e.g. a hatchery to provide transport where the number of birds being transported are of an economical number and the use of personal and public service vehicles. Data is not available on the different proportions, transportation of birds or the use of vehicles and containers.

Hatching egg (HE) collection vehicles, equipment, packaging material and staff not cleaned and sanitized before and after visits as the standard vary greatly: this is not a problem at Kenchic, but is a problem at some of the other hatcheries. Data on hygiene and sanitary standards in most hatcheries is lacking.

Most drivers do not follow biosecurity procedures when moving from hatcheries and farms to other poultry enterprises. This is a major problem in Kenya, although biosecurity measures are applied in some farms, especially large scale commercial farms, but there is no documented information on adherence by drivers to biosecurity procedures

Disposal of non-hatching eggs, unhatched eggs, culled chicks and contaminated packaging materials is a problem in this country. Day old chicks (cockerels) are often sold in open air markets. Backyard farmers buy them to improve their indigenous chicken. They are believed to have been bought from hatcheries at an extremely low price. No data is available on the proportion of the backyard farmers affected nor the proportion of cases in which this takes place.

The disposal of manure and its environmental implications is a very big problem in this country. Commercial farms use raw poultry manure and dairy cattle feeds as fertilizer and also sell this fertilizer to other farmers for the same use. Documented information on different methods of manure disposal from commercial farms in terms of identification of the practices, number of practicing farmers and the amount of manure involved at any given time is lacking.

Inadequate cleansing and disinfection of catching vehicles, equipment and bird containers are not a problem in the country, but poor staff hygiene and lack of clean protective clothing are a problem. This is very common in the small scale commercial poultry units and some of the large scale farming systems. Over 80% of the small scale farmers do not practice good staff hygiene, including use of Personal Protection Equipment (PPE).

Birds going to more than 2 abattoirs are a common scenario in this country. Abattoirs for indigenous chicken are attached to terminal markets. At these points, traders from other satellite slaughter sites and kiosks in the cities also converge. There are 7 of these in the country. The volume of birds moved from main slaughterhouses, to kiosks to other slaughter sites in cities and towns is not documented. Lack of integration, e.g. DOC, HE suppliers, feed mills, abattoirs belonging to different actors, is a problem in this country. There is no integration in small scale commercial farms nor the whole of the backyard system. The proportion of integrated commercial farms and the level of integration have not been documented.

Different age groups of birds on any one farm not separated and are a common problem in the country. In the backyard system, different age groups of different poultry species (geese, chicken, ducks and turkeys) reared together. This problem is common in most of the indigenous / backyard systems. This constraint is not a problem in the commercial system.

5.8 Imports

There are two systems of imports into the country, legal and illegal. The extent and quantities of both categories of trade is not well documented. The legal points/ports of entry of poultry and poultry products include Lunga Lunga, Loitotok, Namanga, Busia, Malaba, Isebania, JKIA, Moi International airport, Wilson airport and Mombasa (Kilindini) sea Port. On land, trade is routinely on going between Kenya and its neighbouring countries, which include Uganda, Tanzania, Sudan, Ethiopia and Somalia. The main commodities traded include live poultry, DOCs and eggs.

All the countries bordering Kenya have been free of HPAI except Sudan, which confirmed two outbreaks in April and September 2006 in Khartoum and Juba, respectively. The cases in Sudan were contained and no more cases have been reported since then.

The border controls are manned by various groups of stakeholders that include Public health, customs, Kenya Plant Health Inspectorate Service (KEPHIS), Police and sometimes veterinary officers. The level of vigilance at the ports of entry varies from place to place. At JKIA, Moi International Air Port and Kilindini harbour (Mombasa), government veterinarians are supposed to inspect all cargo before clearance. This is in respect to all livestock products, livestock by-products and veterinary inputs. At the boarder towns, inspection should be done through the veterinary officers/inspectors in collaboration with customs officers. However, enforcement of rules and regulations governing the movement of poultry and poultry products is very weak (Mutai and Orot, personal communication). This could be attributed to either lack of veterinary inspection staff or lack of awareness on what should be done by other stakeholders, which includes customs officials, public health officers, KEPHIS staff and law enforcement officers.

Apart from the legal points of entry, there are various informal and illegal points of entry that pose a great risk to avian influenza incursion. These are mainly by land and water, i.e. sea and lakes (Turkana and Victoria).

There are various illegal points of entry for poultry and poultry products, including movement from Uganda across Lake Victoria through various Islands such as Mageta, Oyamo, Ndeda and Uyawe. There are also many illegal points by land along the border with Uganda and Tanzania. These porous areas along the border were observed during a risk assessment carried out along the Kenya and Tanzania borders. There are also exchanges of poultry between relatives along the border, as many families have relatives across borders. The quantity of live poultry, mainly chickens and eggs, that cross the border along illegal entry points is unclear. It was noted that a lot of eggs and live birds cross the border points very close to the major towns that also serve as markets for such commodities. The number of eggs moved as illegal imports along the Busia and Malaba towns range from several trays to many pick up loads of trays per week (Kadenge, personal communication).

There is no documented work on the motivation for the thriving illegal trade in poultry and poultry products. Casual observation, however, point at price differentials between the neighbouring countries, cultural and social relations between communities living across the boarder and tendency to avoid payment of custom duties as possible reasons for the illegal movement.

There is no structured documented information on the movement of poultry and poultry products in the country, but preliminary risk assessment studies indicate that there is widespread movement of the commodities. The means of transport used range from hand hawking to bicycles, carts, motorcycles, private saloon cars, pick-up trucks/vans and public service vehicles (Figure 14).

The extent of the control on movement of poultry within the country is negligible or non-existent. This happens despite the clauses in the Animal Diseases Act, Cap 364. This also happens even though there are some Notifiable diseases that are endemic in the country e.g. ND.

Figure 14 Modes of chicken transport in Kenya

5.9 Knowledge gaps in the poultry sector and biosecurity

There are various areas that require studies in reference impediment to poultry production, poultry and poultry products trade and marketing in Kenya that include:

- Gaps exist to identify all the actors in the formal and informal sector, e.g. egg and chicken sellers, their numbers, proportions, turnovers and specialization. Therefore, quantification of key actors is necessary to allow planning and policy formulation in the industry.
- There are many processed chicken products in supermarkets; these processors have not been identified and their linkages with other poultry players are poorly understood.
- Documentation of all feed millers, processors and their level of integration.
- Poultry census especially the indigenous birds. This is because there are various and conflicting estimates of poultry figures depending on the sources consulted.
- Inventory of all hatcheries, their status and performance, including the village based traditional hatcheries to be studied and documented.

- Routine animal health and husbandry practices being done at the breeder farms and hatcheries: identification of practices, frequency and product sources are not documented.
- Use of ethno veterinary: its extent, successes, failures and potential role of this approach, which is widely practiced, should be documented.
- A gap exists to identify all the players in the informal sector, egg and chicken sellers, their numbers, turnovers and specialization.
- Other poultry species: their roles, numbers, distribution and the risk of HPAI associated with them.
- Different approaches to integration, e.g. the role of group formation is not well understood.
- Utilization of other poultry by-products, such as feathers and offal.
- Vaccination of poultry from the backyard system: coverage by age, species, frequency in terms of intervals and geographical areas and identification of the effective means of improving the coverage.
- Breeding practices in the backyard system and the role of cock exchange practices in the spread of disease.
- Information on different sources of breeding material for the backyards system not documented.
- Identify the different methods used in the transportation of live birds and DOC from source to the production units.
- Quantification of Poultry manure produced from the intensive poultry production systems, and the current disposal and utilization methods.
- Flow of live birds from main slaughterhouses to kiosks and other slaughter sites within cities and towns (volumes, site mapping actors and their numbers).
- Integration in the commercial poultry systems (type of integration, level of integration and the number of integrated systems).
- Investigate the hygiene and sanitary practices in all the commercial hatcheries.
- Mapping of poultry live bird markets in the country and the volume of trade and trade governance.
- Mapping of poultry and product routes in the country.
- Documentation of all the poultry and poultry products brought into the country and their destinations over time.
- Documentation and mapping out legal and illegal imports of poultry and poultry products (type, quantity, and country of origin, how long trade has been carried out) over time.
- Study the main drivers of the lucrative illegal and legal trade in poultry and poultry products and the relative importance of these factors.

6. Previous HPAI research and findings in Kenya

6.1 Previous studies

HPAI is one of the emerging diseases in the world; others include Bovine Spongiform Encephalopathy (BSE) and Severe Acute Respiratory Syndrome (SARS). Perhaps as a result, very few studies have focused on the disease. In Kenya, for example, only two studies have been done on HPAI. Kimani (2006), under the auspices of the Department of Veterinary Services (DVS) and the Pan-African Programme for the Control of Epizootics (PACE), assessed the socio-economic impacts of the September 2005 avian flu scare in Kenya. The focus was on the impact of the avian influenza threat on household and business incomes, farmer perceptions, production patterns and coping mechanisms. The data was collected using a participatory rural appraisal and a questionnaire survey of 319 poultry farmers and 158 businesses in eight Districts in Kenya between May and June 2006. The study found that the threat of disease had triggered key reactions among poultry meat consumers and poultry farmers. There was a reduced demand of poultry meat. However, Kimani did not assess the magnitude of this reduction in demand. On the other hand, poultry farmers reduced their flock sizes between 2% and 39% due to premature selling, postponement or cancellation of day old chicks and unavailability of new chicks as hatcheries also reduced production. Sales volumes were reduced among poultry traders and poultry product outlets (hotel industry). Faced with high operating costs, these businesses laid off many workers. The number of jobs lost has not been quantified. The total monetary loss for the study sample was estimated to be Ksh 0.4 billion which rose to KSh 2.3 billion when extrapolated to the rest of the industry, excluding the cost of the preparedness measures instituted by the government for prevention and control. The study concluded that the avian flu scare had a substantial impact on the poultry industry, and therefore both the Ministry of Health and the DVS should design ways of preventing consumer panic and the spread of the disease within the country if an outbreak occurs.

The Food and Agricultural Organization (FAO) studied the structure and importance of the commercial and village based poultry systems in Kenya with regard to HPAI risk. The aim was to recommend safe poultry production systems in Kenya. Stakeholder interviews and farm visits were conducted in the four production systems in various parts of the country. The study found that biosecurity flaws were present in all the four production systems with regard to wild bird contact, human traffic control, and waste disposal. The poultry marketing chain involving primary collectors at the village level, secondary collectors at the District level and sales at the Provincial and urban markets also had serious biosecurity flaws. Slaughtering processes in all but the industrial sector posed severe biosecurity flaws with respect to the isolation and processing of birds, waste disposal and movement of personnel. The study concluded that because of the serious biosecurity flaws in all the four poultry production systems and along the food chain, different strategies are needed to deal with these flaws in the respective sectors. To start, training and public education on good and safe poultry production and standard biosecurity measures was needed to safeguard food safety in order to reduce the possibility of spreading poultry diseases. The study recommended that sanitation protocols be designed and implemented in slaughterhouses and a compensation mechanism be found to mitigate future losses in case of a new threat or an actual outbreak of HPAI in the country.

6.2 Research gaps

Although Kimani (2006) and FAO (2007) provide important baseline data on the poultry production systems in Kenya with respect to HPAI threat, more socio-economics research is needed. Such studies would corroborate the findings of previous studies. The effective containment of HPAI outbreaks depends critically on rapid reporting and control measures. Experience has shown that reporting can be significantly encouraged through the establishment of compensation mechanisms to defray the extent of economic losses resulting from control programs, especially in developing countries. However, although desirable, payment of compensation can raise complex issues. Sones (2006) highlighted some reports of poor poultry owners in Nigeria hiding their birds from official culling teams as compensation was considered inadequate, and of villagers being arrested for feeding on culled birds retrieved from disposal pits. In such situations, research is needed to guide the design of appropriate compensation mechanisms in order to avert losses arising from either actual or perceived threat of HPAI outbreak. One of such mechanisms could involve poultry insurance. Given that agricultural insurance schemes have not fared well in developing countries, research would provide information on what works, where and how. Additionally, research is needed to map out "hot spots" of concentrated poultry products, particularly live birds, along the value chain as this would be an important pathway in disease transmission. Simulation studies are also needed to quantify the magnitude of the impact of previous and future HPAI threats.

Early warning systems are essential tools for the management and control of highly infectious diseases such as the HPAI. Research is therefore needed for the design and implementation of appropriate early warning systems to assist in disaster management if an HPAI outbreak were to actually occur in Kenya. Research is also needed for evaluating the cost-effectiveness of alternative disease control measures, and identifying the costs and benefits of these measures for different socio-economic groups in Kenya.

7. Economic Impacts of HPAI

7.1 Background

Kenya had a major HPAI scare in September 2005. The scare was prompted by media reports that showed dead birds in Nakuru and Kasarani in Nairobi. This spread fear and panic throughout the country from January to March 2006. The panic was attenuated by an outbreak of Avian Influenza in Southern Sudan. It is against this backdrop that Kimani's study was undertaken in May 2006 to assess the economic impact of the scare. We could not find any other study that has assessed the economic impact of the AI scare in Kenya.

7.2 Economic impacts of HPAI

As described earlier, Kimani's study was carried out in six of the eight provinces where 319 households were surveyed (see Table 15). The respondents were asked to state the flock sizes as of September 2005 and May 2006. Table 29 gives the farmers' responses.

Table 29 Changes in mean flock sizes in September 2005 and May 2006

Poultry type	Owning HH (%)	Mean – Sept 2005	Mean – May 2006	% change
Indigenous chicken	64	43	29	-32.6
Layers	34	466	476	+2.2
Broilers	30	1,164	805	-30.8
Turkeys, ducks & geese	8	34	14	-58.8

Source: Kimani (2006)
HH = Household

Among the farmers who reported negative effects, 25% had panic-culled their birds. The highest proportion (52%) of those who culled their birds reared indigenous chicken, while 40% reared layer and the rest kept turkeys, ducks and geese. Broiler farmers did not dispose of their birds abruptly because the market has minimum weight specifications. Table 30 compares the mean number of birds culled prematurely to those culled normally and the associated loss of revenue.

Table 30 Comparison of the number of birds culled prematurely and those culled normally and associated revenue lost

Poultry type	Mean number culled prematurely		Mean age (months) at		Mean price (KSh) at		Mean revenue lost (KSh)
	Full sample	Amongst HH keeping the poultry type	Premature culling	Normal culling	Premature culling	Normal culling	
Indigenous chicken	10	50	20	25	164	223	3,108
Layers	48	248	21	26	106	147	9,745
Turkeys, ducks & geese	14	44	21	27	375	538	7,050

Source: Kimani (2006) HH = Household

It is unclear how revenue lost was calculated. Kimani (2006) goes on to say that when the opportunity cost of foregone production is included, the total loss associated with premature (or panic) selling was KSh 813,810 among the 319 households interviewed. Kimani (2006) also reports

that 72% broiler farmers and 52% of layer farmers cancelled bookings for day old chicks. As a result, hatcheries lost business from these cancellations. The total loss as a result of cancelled bookings was calculated to be KSh 3,202,950 for the entire sample of 319 households.

The prices of poultry and poultry products were also affected by the HPAI scare. Table 31 shows the prices changes before and during the HPAI scare amongst the 319 households surveyed by Kimani in 2006.

Table 31 Mean farm-gate prices for poultry and poultry products before and during the AI scare in surveyed districts

Product	Duration	Mean price (KSh)								
		Unit	Full sample	KK	Kbu	Mks	Mbsa	Nbi	Nku	T/T	U/G
Broilers	Before	Kg	226	-	215	220	234	239	203	220	230
	During		192	-	176	189	212	195	173	200	197
Indigenous eggs	Before	Tray	166	150	160	155	180	220	148	158	163
	During		154	145	137	140	150	203	108	152	150
Commercial eggs	Before		150	145	154	165	180	147	139	150	148
	During		127	129	122	136	180	129	117	130	130
Indigenous chicken	Before	Kg	219	198	213	193	160	243	150	188	200
	During		161	164	132	120	200	174	90	176	168
Spent layers	Before		156	140	150	130	150	120	140	183	148
	During		110	103	112	100	160	80	88	143	102
Turkeys, ducks & geese	Before		512	-	-	-	-	-	-	-	-
	During		375	-	-	-	-	-	-	-	-

Source: Kimani (2006)

KK = Kakamega; Kbu = Kiambu; Mks = Machakos Mbsa = Mombasa; Nbi = Nairobi; T/T = Taita Taveta; U/G = Uasin Gishu

7.3 Information gaps

Although FAO (2007) mentions the severe negative impact of the HPAI scare in Kenya, it does not give data on the magnitude of that impact. Specifically, there is no information on the following:

- Costs of culling and other measures taken to contain the disease
- Costs of compensation (actually, no compensation was made)
- Number of businesses that went bankrupt. Mr Anthony Wainaina, the Sales and Marketing Manager of Kenchic Ltd was quoted in *Business Sunday* (Githahu, M., Sunday Nation/January 15, 2006) noting that the 2005 avian flu scare came close to wiping out about 50% of Kenya's poultry industry. However, there is no information specifying which businesses were affected most and by what magnitude
- Number of people who lost jobs as a result of the scare – whether temporarily or permanently. FAO (2007) observes that jobs were lost in poultry-related industries but provides no data to that effect
- The effects of the HPAI scare on the domestic consumption of poultry products – FAO (2007) indicates that there was a severe drop in demand for poultry meat and eggs, drop in purchase of day old chicks for broiler and commercial layers and boycott of poultry products from fast food restaurants and that many homes removed poultry from home menus. No data exist to substantiate these claims.
- Impacts on other industries in the poultry value chain
- Losses in poultry export revenues

8. Threats and Incidences of HPAI and Institutional Response Capacity

8.1 Poultry diseases in Kenya

Poultry diseases have been reported to occur in the country varying both spatially and temporally. There are very few structured epidemiological studies that have been carried out in the country. The few studies carried out cannot be extrapolated to represent the disease picture of the whole country. The other source of information is from government annual reports that are mainly based on tentative diagnosis from field reports (DVS, 2001 and 2002).

The main diseases that have been incriminated that cause major loses include Newcastle, fowl typhoid, Gumboro, coccidiosis, helminthisosis and fowl pox. Three of these, Newcastle, Fowl typhoid and Gumboro, are the main differential diagnosis in Kenya. Studies carried out in different parts of the country have quantified the main causes of the major poultry diseases. Studies by Okuthe (1999) in the Uasin Gishu district quantified the prevalence of Newcastle disease and fowl typhoid in a study carried out over a period of two and a half years. Work by Olwande (2008) found that Newcastle, Fowl typhoid and Coccidiosis were the most important diseases constraining smallholder farmers in the Rachuonyo and Rongo districts in South Nyanza of Nyanza province. Studies carried by Okitoi (2006) and Ondwassy (2005) also ranked Newcastle disease, Fowl typhoid and Cocciodiosis as the major poultry diseases that constrain poultry production.

No cases of avian influenza have been confirmed and reported in Kenya despite several suspect outbreaks in various parts of the country, especially those incriminating wild birds (MoLFD, 2006). Deaths of wild birds have been reported from various parts of the country including Turkana, Wajir, Garissa, Tana River, Tavetta, Moyale, Isiolo, North Pokot and Lake Nakuru (Wanjohi, personal communication). Investigations have been carried out and documented from various studies. Three outbreak investigations have been documented by Ojigo et al, 2007 and 2008. These investigations were carried out in the North Eastern and Coast provinces (Wajir, Garissa, Tana River) and two in Turkana North district involving domestic and wild birds.

Diseases are the major constraints to poultry production in Kenya as identified by several studies and findings (Okuthe, 1999, MoLFD, 2005, Okitoi et al, 2006 and Mungube et al, 2007). The major diseases identified include Newcastle, Gumboro, Fowl typhoid, Coccidisosis, fowl pox and helminthosis, Mareks, Coryza and Chronic Respiratory Diseases. The two main diseases that limit all poultry production systems are Newcastle, Gumboro and Fowl typhoid. These are also the diseases that would confuse the primary stakeholders in the poultry industry i.e. producers / farmers.

Disease control regimes in place are on the lower end in this sector. Newcastle disease is the most important disease of poultry in this sector in the free range scavenging poultry production system that involves mainly the rearing of indigenous chicken. The disease is experienced in the cool months of the year, mainly from May - July and November - December. During ND outbreaks, mortalities of 90-100 % are realized leading to huge losses for farmers and traders. The magnitude of losses due in percentage is the same in all the zones but in numbers, it is very high in the lower zones. Farmers are not keen to report the disease because they say they do not expect much assistance from the government, having proved the inadequacy of the veterinary staff to effectively attend to all farmers.

This is due to the dwindling number of staff in the field. In most of the 146 districts in Kenya, there is only one veterinary officer who is expected to undertake all the administrative, technical and regulatory roles. This hampers delivery of animal health and extension services by the veterinary department.

The use of Indigenous Technical Knowledge (ITK), especially herbal treatments, is very common in the indigenous free range and back yard system for the control and treatments of diseases. The most common herb used is *Aloe Vera*, though other farmers combine it with Neem, *sonchus spp* pepper, croton leaves, red *amaranthus spp* and Guava leaves. Farmers have reported that such a mixture is able to protect flocks against ND. Vaccination against ND is slowly increasing, especially in the areas of Rongo, Migori, Rachuonyo, Makueni and Bomet as a result of awareness creation through projects and the economic benefits being realized from poultry (Olwande and Kariuki, personal communication).

Farmers/producers practice very risky behaviours during seasons of disease outbreaks that can facilitate the spread of diseases (Cheruiyot and Marusoi, personal communication). These practices include the selling of poultry due to fear of flock infection. Some farmers may sell when they find one bird in the flock is infected. This facilitates the spread of diseases through the markets. Sick birds are sold cheaply and some hotels buy them because of the profit margins. Other risky behaviours by farmers include the slaughtering of sick chicken to avoid unnecessary losses, as farmers believe that poultry diseases will not and cannot affect people, and the smoking of dead birds that are eaten and usually thrown to dogs when not consumed by people in raw form.

The main source of information on diseases in Kenya is in the form of passive reports of notifiable diseases and research instituted findings that have not been published in refereed journals or proceedings. Reports from the Department of Veterinary Services (2001 and 2002) reported various cases and outbreaks during the two years. There are also previous annual reports that indicate the same. Structured epidemiological studies on the occurrence of diseases are scarce. This is one of the areas that should be prioritised because it is important to have well documented facts on different diseases that would add value in the risk analysis studies.

The main source of reports on diseases is usually consolidated into an annual report by the Department of Veterinary Services. The report does not give incidences but only reports on the number of outbreaks by district. This gives little or no quantitative information on the occurrence of the major poultry diseases. Table 1 shows some prevalence of the main diseases that have been reported from structured studies.

There are no official control programmes by the Department of Veterinary Services although the department avails vaccines that are used in the field for vaccination at a cost. The latest reports available on the number of vaccines that have been used are shown in Table 32. The involvement of public veterinary services in service provision is very poor in most parts of the country (Odera, 2007).

Table 32 Quantities of vaccine used to control poultry diseases in Kenya (2001 and 2002)

	Disease	Year	
		2001	2002
1.	Newcastle disease	550,985	242,284
2.	Fowl typhoid	160, 979	34, 368
3.	Fowl pox	18,434	113,043
4.	Gumboro	207,744	4,109

Source: Annual report Department of Veterinary Services (2001-2002)

Poultry disease control is mainly carried out by the private sector. Private animal health service providers either visit the farms or sell prophylactic drugs to the farmers. Most of these drugs are administered by the farmers themselves especially the commercial poultry producers. The drugs are administered either in feed or drinking water.

8.2 Research and information gaps on poultry diseases

Lack of structured studies and information on disease prevalence for the major poultry diseases in all the production systems is a hindrance to effective disease control. The available information is very scanty and therefore will affect planning of disease control strategies. Information on disease control by private AHSPs is poorly documented, hence the lack of information on the role of this cadre of service providers who are key stakeholders in the poultry sector.

8.3 Highly pathogenic avian influenza

To date, no case of HPAI has been isolated or confirmed in the country. This has been revealed by both active and targeted surveillance carried out in different parts of the country. The major threat was during the outbreak of avian influenza that was confirmed in Khartoum and Juba in Sudan in September 2006. This occurred because the two countries share a common border and also have a lot of human traffic between them. The Department of Veterinary Services has carried out targeted and passive surveillance at the border point with Sudan (Ojigo *et al*, 2007). The department has also improved on vigilance at the border points with Sudan.

The government has identified bird flu as a Notifiable disease (1998). A multi-sectoral task force has been set up to prepare and coordinate an avian flu preparedness and response plan. The government has also banned the importation of poultry and poultry products from countries or areas with confirmed avian flu outbreaks. It has also tightened controls of their importation at all ports of entry (air, water and land).

In view of the avian influenza scare that occurred between the months of October 2005 and April 2006, a National Task Force was formed to oversee the activities of preparedness in reference to early detection, prevention and control of avian influenza. The Ministries of Livestock and Fisheries Development and the Ministry of Health formed the task force as the lead bodies. Other members of the task force are derived from donors, NGOs, civil societies, universities and stakeholders from the poultry industry. A number of stakeholders from government ministries, humanitarian organisations, and the public and private sector participated in coordinating under the auspices of the government of Kenya. The stakeholders include the Ministry of Health (MoH), Ministry of Livestock Development (MoLD), International Livestock Research Institute (ILRI), World Health Organisation (WHO), National Museums of Kenya (NMK), Centre for Disease Control (CDC), World Bank and United Nations Food

and Agricultural Organisation (FAO). Others include the Ministry of Special Programmes – Office of the President, African Union – Inter-Africa Bureau of Animal Resources (AU-IBAR), Kenya Red-Cross Society, Ministry of Finance, United Nations Development Programme (UNDP), USAID/Kenya, Walter Reed Project, University of Nairobi, Ministry of Tourism, Ministry of Forestry and Wildlife, Sanofi Pasteur, Centre for Virus Research – Flu surveillance Network, Department of Immigration, Kenya Wildlife Services and the United Nations Children Fund (UNICEF).

The task force is divided into six sub-committees that include epidemiological surveillance, laboratory and research, infection prevention and control, case management, information, Education and Communication and Social Mobilisation and coordination and resource mobilisation.

The National task force established a National Action Plan that is established along the FAO and WHO guidelines and strategy. The plan covers both animal and human aspects of prevention and measures to counter the disease, should it occur. The plan contains necessary emergency preparedness measures. The National Action Plan was prepared along with activities of the sub-committees. The guiding principles include taking a multi-disciplinary approach to prevention and control, safeguarding human life and the national poultry flock, implementing the plan in accordance with established guidelines set by the international human and animal health organisations involved in global HPAI control, protecting the livelihoods of the general public, commercial and smallholder poultry farmers and management systems that will be continually be assessed to ensure that response functions are flexible and dynamic to take into account the evolving nature of the situation, with the provisions in the plan being periodically revised and updated to reflect the new knowledge and new development.

The strategy as outlined in the plan is 2 pronged, i.e. animal health – prevention, control and eradication and human health – prevention, control and response.

The animal health component has an elaborate surveillance network comprising both the public and private veterinarians and other stakeholders, including livestock keepers and traders, as part of the country emergency preparedness programme. This component has been exhaustively covered by the avian influenza contingency plan that has been developed in a participatory manner by FAO and the Department of Veterinary Services. This is part of developing sustainable, effective and efficient emergency preparedness for the major transboundary animal diseases.

The contingency plan has been thoroughly discussed both internally at the departmental level and also externally with other stakeholders in the poultry industry. The contingency plan has been presented to the Chiefs of Divisions at the departmental headquarters based at Kabete, provincial Directors of Veterinary Services (PDVS), Veterinary officers at the provincial and district level, other stakeholders manning the points of entry into the country (customs, police, public health and local authorities). Feedbacks have been received that have been included in reviewing the contingency plan that is now ready for implementation.

8.4 Overview of wild birds and migratory patterns

Kenya lies along the migratory birds' route from Europe to Southern Africa and is a stop over point for many species thereof. Birds start to arrive in mid-September and peak in mid-November. Migratory birds stop at water points and mix freely with local water birds. Therefore, understanding

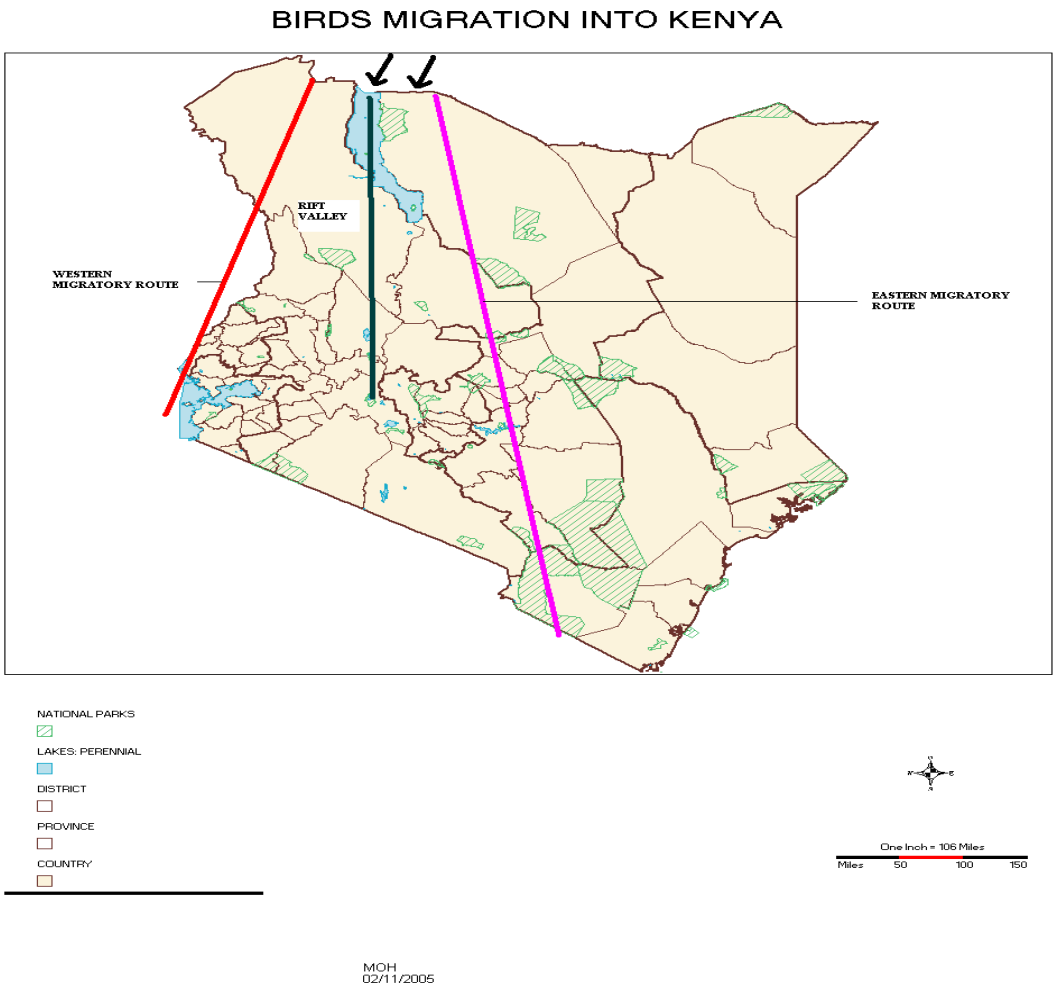
the migratory pattern of wild birds in Kenya is necessary as one of the steps towards effective emergency preparedness.

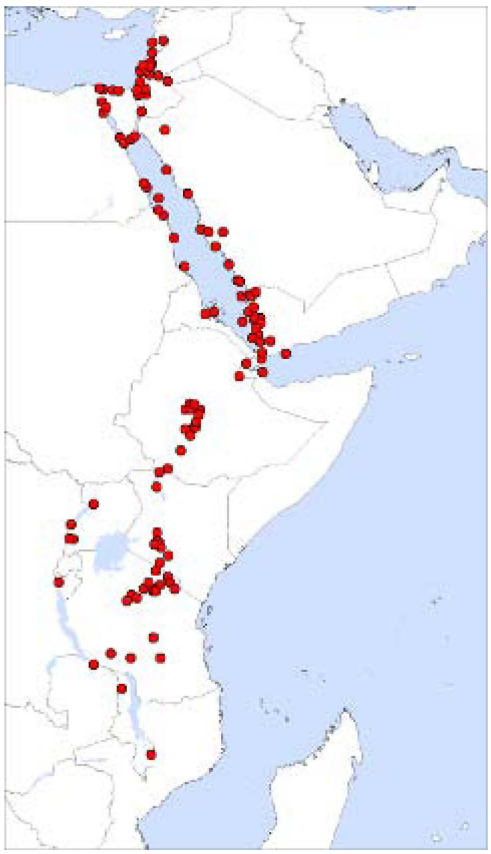
It is estimated that some 270 species of birds migrate into Kenya. The two types of migration that are observed are *short-distance migration* and *local movements:* this includes the movement of birds between various Rift Valley lakes, e.g. movement of lesser flamingos between lakes Magadi in Kenya and Natron in Tanzania, and v*ertical migration*: this involves a change in altitude, e.g. Golden-winged Sunbird and long-distance migration. This involves journeys of hundreds or thousands of kilometres and is classified in different systems among which the Palaearctic-African migration could be a concern for Kenya.

8.4.1 Migratory bird flyways in Kenya

The birds enter the country from the North and follow the Rift Valley during the months of September to December as they migrate southwards. They follow the same pathway as they migrate back to the North in the months of March to May. The Rift Valley lakes are vital for migrant water birds, acting as guiding landmarks, breeding grounds as well as stop over points.

Figure 15 Wild Bird Migratory Pathways and Landmark (Lakes, Highlands) in Kenya





Wild birds Migratory pathway and possible hotspots following

Lakes Nakuru and Elementaita are good examples which have the largest numbers of flamingoes and pelicans congregation in the world

Migratory wild birds and interaction of birds of different bird species in Lake Nakuru

Source: Kenya avian influenza contingency plan, 2008

There is a potential risk of introduction of HPAI in Kenya by migratory birds. There is ready interaction between the wild birds and the scavenging domestic poultry of sector 4 (FAO, classification). The high-risk season starts from mid-September to December and after, when birds are arriving from the North in migratory spots. An example of a case study on the interaction of wild resident and migratory birds is detailed for the Keiyo district in the Rift Valley province (Figure 16).

Figure 16 Bird movement patterns and birds' interacting with domestic poultry in sector 4

Crested cranes are normally seen in the months of February and March during the ploughing period after which they disappear until August to October when maize is ready for harvest in the farms. White egrets appear in October to November after the annual maize harvest. The crested cranes and white egrets live in large farms and nearby forested areas. They then leave after the farms are ploughed in January and February. Black water ducks are common most of the time but increase in number from April to June. The water ducks leave live in dams along the plateau in the district. The dams in Keiyo district are Sing'ore, Chebokokwa, Charara, Katalel, Kipsoen, Yokot, Kaptarakwa, Kipkabus, Lolkarin and HZ.

Different species of wild birds have been reported in Remoi National reserve conservation area where Kapnorok lake/dam is located. They include Hamerkop, Hadada Ibis, Egyptian goose (occasionally), Black kite, Quail, Helmeted Guinea fowl, Speckled pegion, Ring –necked dove, Laughing dove, Emerald – spotted wood dove, White bellied – go –away- bird, African barn owl, Speckled mouse bird, Malchite Kingfisher, Pigmy Kingfisher, Lilac – breated roller, Rufons – crowned roller, Hoopoe, Ground hornbill, Red billed hornbill, Vond Decking's hornbill, Red and yellow barbet, African pied wagtail, Common bulbul, Thrush (olive thrush), Black-headed Gonolek, Common Drongo, Greater Blue – eared startlingf (blue eared glossy starting), Ruppel's long-tailed startling, Superb startling, Sunbirds, White headed buffalo weaver, White-browned sparrow weaver, Black headed weaver, White-bellied canary, Golden breasted bunting, Pied crow and Red cheeked blue cordon

Source: DVO, Keiyo district report (2008) by Dr. Chege Munderu.

Surveillance in poultry in areas close to migratory bird routes is necessary to quantify this risk, supported by the water bird count, monitoring, sampling and analysis of viral subtypes. This calls for a multi-disciplinary approach.

In Kenya, the NMK provides the ornithological expertise. An institutional understanding between NMK and the Department of Veterinary Services allows for joint surveillance and outbreak investigation missions.

The KWS is the custodian of the water bodies, all wild animals and birds in Kenya. Most of the water bodies are located in conservation areas, which are a tourist attraction. The involvement of the game wardens and rangers in surveillance of wild birds has been initiated and will be enhanced through joint training workshops.

Other organisations concerned with bird conservation activity such as site groups, bird watcher associations, private bird sanctuaries, bird shooting expeditions groups and tour guide companies get their mandate and are regulated by the KWS. Creating awareness and the involvement of these groups in surveillance and reporting of unusual bird mortalities will enhance early detection of NAI.

8.5 Veterinary Services in Kenya

The mandate for the provision of veterinary services in Kenya lies with the Department of Veterinary Services in the Ministry of Livestock Development whose structure is shown in an organogram in

Annex 1. The organogram also shows the linkages between the department and other related institutions.

The country's 149 administrative districts are manned by DVOs who are supported by 6 Regional Veterinary Investigation Laboratories (RVIL) and 3 satellite laboratories that provide disease investigation, diagnosis and surveillance support. Eight Provincial Veterinary offices headed by Provincial Directors of Veterinary Services, who in turn report directly to the Director of Veterinary Services based at the national headquarters at Kabete, Nairobi, supervise the activities at the districts. The public provision of veterinary services in the divisions, locations and sub-locations is mainly done by Livestock Officers (LOs) and Livestock Health Assistants (LHAs).

The private sector employs 130 KVB[8] registered veterinary surgeons, 11 diploma holders and 642 certificate holders. Community Animal Health Workers (CAHWs) are also present in Arid and Semi Arid Lands (ASALs) especially in North Eastern Province and the Northern parts of Rift Valley and eastern Provinces. Among these categories, some qualified service providers could be mandated by the Government to perform official HPAI Epidemio-surveillance and control activities. Diploma (LO), certificate holders (LHA) and CAHWs can also be involved in Participatory Disease Surveillance (PDS).

8.5.1 Legal statutes

The mandate of the Department of Veterinary Services is to prevent, control, and eradicate livestock diseases in order to promote livestock production to ensure food security, wealth and employment creation and facilitation of marketing of livestock and livestock products.

Among these different key roles of the Department, those that will be relevant for HPAI prevention and control include disease and pest control, regulatory functions including veterinary public health and meat inspection, quality control of inputs, laboratory and diagnostic services, provision of extension services, registration of veterinarians and practices, drugs, vaccines, biologicals, chemical substances, development of veterinary policies, creating an enabling environment for private sector and conservation of natural resource base of livestock, e.g. gene bank.

This mandate and the roles are exercised under a legal framework comprising relevant Acts of Kenyan Law that are briefly outlined hereafter in reference to avian influenza related issues.

(a) Animal Diseases Act Cap 364

Provides for livestock movement control and confers on the DVS the powers to destroy infected animals with compensation to livestock owners. It also confers power to exercise sanitary mandate at ports of entry.

(b) The Veterinary Surgeons Act Cap 366

Makes provision for the registration of Veterinary Surgeons, and for other matters incidental to and connected with the practise of veterinary surgery (*accreditation of practitioners*).

(c) Meat Control Act Cap 356

Makes provision for the control of processing, handling and trade in meat and meat products.

[8] Kenya Veterinary Board

(d) Prevention of Cruelty to Animals Act Cap 360

Provides for better provision for the prevention of cruelty to animals, control of experiments on animals and for matters incidental thereto and connected to general animal welfare (*humane culling)*.

(e) Fertilisers and Animal Foodstuffs Ordinance Cap 345

Provides for the regulation of importation, manufacture and sale of agricultural fertilisers. It also provides for animal foodstuffs and substances of animal origin intended for the manufacture of such fertilisers and foodstuffs, and to provide for matters incidental to and connected with the foregoing.

(f) The Pest Control Act Cap 346

The Act regulates the importation, exportation, manufacture, distribution, sale and use of products used in the control of pests and organic function. Products include fungicides, acaricides, insecticides, disinfectants among others. The Director of Veterinary Services is represented on the board which has 16 members and meets 4 times a year.

(g) Public Health Act Cap 242

Makes provision for securing and maintaining public health

(h) Pharmacy and Poisons Act Cap 244

An ordinance to make better provisions for the control of the profession of pharmacy and the trade in vaccines, drugs and poisons. The Act has been severely criticised as a constraint to the delivery of veterinary services since it only allows veterinarians to possess drugs for purposes of treatment but not as stockists.

8.6 Country response to an outbreak

8.6.1 Principles of HPAI prevention and control

The main measures available to prevent, control and eradicate HPAI include effective disease surveillance for early detection and reporting of outbreaks; enhanced biosecurity of poultry farms and associated premises, including marketing chain premises, vehicles and equipment; control of movement of birds and products that may contain virus, including controls at the interface of infected and uninfected areas; changes to industry practices to reduce risk, rapid, humane destruction of infected poultry and poultry at high risk of infection, disposal of carcasses and potentially infective material in a biosecure and environmentally acceptable manner and proper use of vaccination.

None of these risk reduction measures implemented alone will be sufficient to prevent, control or eradicate HPAI. Rather, they must be implemented in combination and supported by surveillance to ensure early detection and rapid response to viral incursions. Public education and awareness campaigns are also important to help in controlling the disease and to safeguard public health. An appropriate disease control regulatory framework together with adequate physical, financial and human resources should be in place for effective prevention and control of HPAI.

The control of HPAI is achieved by reducing the amount of virus circulating in poultry and on farms. Measures such as stamping out, disposal, cleaning, disinfection and vaccination are implemented to

reduce the amount of virus present. Additional measures, such as movement controls, enhanced biosecurity and, as appropriate, vaccination are implemented to create barriers between uninfected poultry and foci of infection.

Biosecurity is the first line of defense against entry or spread of infectious agents into or from premises containing poultry. Effective biosecurity includes those measures that are applied to exclude (bio-exclusion) introduction of disease causing agents into a farm or premises and also, those measures that are applied to contain (bio-containment) infectious agents within the farm or premises.

Effective biosecurity and epidemio-surveillance systems (see surveillance section) are based on a good understanding of the poultry value chain including production, transportation, processing, marketing and trade. This also depends on knowledge of the patterns of migratory wild birds and risk analysis for introduction of the highly pathogenic avian influenza virus into the country.

8.6.2 Surveillance of avian influenza

(a) Case definition for chicken

A suspicion for HPAI will be based primarily on the clinical symptoms in poultry that include respiratory problems (gasping, coughing), haemorrhages on non feathered areas of the skin (legs), combs and wattles that are swollen and cyanotic, high mortality – increase in mortality -50% above the average, mortality over 60% in 48 hours, swollen face and necks, sudden onset of depression, sudden drop in egg production and neurological signs e.g. twisted necks and ataxia.

The presence of a sufficient number of concurrent symptoms will lead to establishment of the suspicion and subsequent sampling and use of the rapid antigen test (RAT).

(b) Epidemio-surveillance System

A risk-based surveillance system is in place. The DFID funded avian influenza programme that was being implemented by FAO in collaboration with the Department of Veterinary services has strengthened the epidemio-surveillance network for HPAI. Efficient field surveillance by the animal health service providers and other relevant actors in the poultry value chain is key to the early detection of an incursion of HPAI. The success of this surveillance relies greatly on improved disease reporting by the poultry owners and a rapid response that provides prompt investigation of the disease outbreak. At the end of the project, the DVS will have an efficient surveillance system in place. The strengthening of the surveillance system through training of veterinarians and para-veterinarians has led to slight improvements in reporting and a better working relationship with the 6 Regional Veterinary Investigation laboratories spread across the country (Mariakani, Garissa, Karatina, Nakuru, Kericho and Eldoret).

Kenya has developed during the past decade a national epidemio-surveillance system (ESS) in accordance with Cap 364 of the laws of Kenya. Epidemiosurveillance involves both passive and active surveillance.

(c) Passive Surveillance

Passive surveillance for HPAI is conducted by both public and private Animal Health Service Providers (AHSPs) during routine fieldwork. Each district operates a rumour register where all cases of reported unusual mortalities in poultry are recorded and subsequently investigated by the DVO or the Regional

Veterinary Investigation laboratories (RVILs). When clinical cases similar to HPAI are not encountered, the AHSPs fill Geographic Information Systems (GIS)-compatible HPAI Zero Report forms (Annex 5). The forms are submitted monthly to the Veterinary Epidemiology and Economics Unit (VEEU) for analysis and data capture using Access database and Arc View. Other methods of relaying information on passive surveillance are through monthly, quarterly and annual narrative reports, telephones and radio calls. The DVS reports to OIE, AU-IBAR and policy makers on a regular basis. Feedback is made to the field personnel, farmers and other stakeholders through workshops, official letters, telephones and radio calls.

(d) Active surveillance

Active surveillance activities include disease surveys, outbreak investigations, participatory disease searching (PDS) and disease search. Active surveillance in wild birds is carried out through targeted surveys in high-risk areas and outbreak investigation by Kenya Wildlife (KWS) services and the National museums of Kenya (NMK) in collaboration with the DVS.

The DVS AI surveillance programme has put in place early detection and rapid response system for reporting and responding to suspicious cases. Farmers and members of the public report any suspicions of HPAI to the nearest Veterinary office or call the DVS through telephone hotline 0722 726 682 or send an email to dvs@dvskabete.go.ke.

Active surveillance data is captured using GIS compatible HPAI outbreak investigation questionnaires and analysed by VEEU. All active surveillance samples are submitted to CVL for analysis. Reports from the analysis are disseminated at the national level to AU-IBAR, OIE, policy makers and neighbouring countries. The number of samples collected should allow early detection of cases in a 5% infected flock with 99% reliability during surveillance.

(e) Early warning

Effective surveillance enables early warning and rapid response. Different surveillance activities will be implemented in different phases: suspicion, confirmation of suspicion, pre-diagnosis, diagnosis and confirmed diagnosis. Suspicion will be made on clinical investigation using the case definition and the Rapid Antigen Test (RAT).

(f) Control

The principle of rapid response and control ensures containment of outbreaks. In the case of positive RATs on dead, sick or moribund birds, the DVO in consultation with the Director of Veterinary Services will impose a provisional quarantine in the epidemiological unit as they wait for the result from CVL. Once the preliminary diagnosis is confirmed, sanitary measures will be extended: delineation/zoning, culling, movement control, markets closure, etc. based on the risk analysis. Communication activities for the outbreak period will be initiated.

8.6.3 Diagnosis of HPAI

This is part of HPAI early detection, prevention and control that compliments surveillance activities. It is important to know when and which samples to collect during disease investigations.

(a) Appropriate samples for diagnosis of HPAI

The appropriate samples for laboratory diagnosis of HPAI include oral pharyngeal swabs, trachea swabs, cloacal swabs, fresh faeces, comb and carcass that should be taken only as a last alternative.

The samples will be packaged in accordance with the guidelines for packaging infectious materials as provided in the global standards. The samples should be submitted to the Central Veterinary Laboratories Kabete using the fastest means available. Different methods for diagnosis of HPAI include Direct detection of viral antigen from tracheal, cloacal and fresh feaces samples, Haemagglutination test, Haemagglutination inhibition test, Real time PCR (rRT-PCR) and conventional RT-PCR and Viral isolation. Serological tests such as AGID and ELISA will be used for sero-surveillance.

Field diagnosis is first carried out through rapid antigen detection where on clinical suspicion of HPAI, cloacal and tracheal samples will be collected and tested for HPAI, Newcastle and IBD using rapid antigen tests. Where swabs cannot be obtained, fresh faecal material will be used. RAT will be used as a first line of diagnosis towards confirmatory diagnosis of HPAI in the laboratory using rRT-PCR and viral isolation. Similar samples from the same birds will be submitted to the national laboratory for further testing preferably within 24 hours of sampling. The field veterinarians and RVILs should always inform the CVL prior to dispatch of the samples. Upon a positive influenza diagnosis on RAT, the local DVO will inform the CVFO while the OIC-RVIL and CVL will inform either CVIO. Both the CVIO and the CVFO will inform the DVS.

Laboratory diagnosis is carried out at the National Laboratory Level and is done at the CVL. Several tests can be performed to give a confirmatory test of NAI. The details of the tests are outlined in appropriate annexes. At the CVL, a rapid antigen test for H5 antigen will be performed at the earliest opportunity. The confirmatory tests are as follows:

(b) Polymerase Chain Reaction

The real time reverse transcriptase polymerase chain reaction (rRT-PCR) for AIV, H5, H7 and H9, and a duplex RT-PCR for simultaneous identification of H5 and N1 will be carried out at the CVL. If positive for NAI, CVL will inform the CVIO who may submit the samples to CDC-KEMRI but should submit the samples to an international reference laboratory for further characterization including pathotyping.

(c) Virus Isolation

Concurrently with the PCR, the samples will also be inoculated into 9-11 days embryonated chicken eggs for viral isolation. The allantoic fluid harvest will be tested for virus using Hemagglutination / Hemagglutination inhibition tests. If positive for NAI, CVIO will be notified and also, the samples may be sent CDC-KEMRI but should be submitted to an international reference laboratory for further characterization.

At the International Laboratory Level, the official diagnosis of HPAI leading to international notification of the disease will be performed in OIE reference laboratory, Padova, Italy or any other.

8.6.4 Outbreak response

The first response to an outbreak in Kenya will be a provisional quarantine in the event that a field diagnosis (at least 5 chickens) shows a positive result for avian influenza and a negative result for Newcastle and IBD based on the use of RAT, the DVO, after consulting with the PDVS and DVS, will impose the first sanitary measures (provisional quarantine) of the premises while awaiting confirmatory results from CVL within 48 hours. The provisional quarantine will be implemented as per the Animal Disease Act Cap 364 L.N.106/1965 Subsections 7: provisions affecting infected areas. It allows the DVS to impose movement control by stating:

No stock shall be moved from or into any infected area or from place to place within such area without the written permission of the Director, or of any person authorized in writing by the Director to give such permission;

In addition, no person shall leave any such area without having complied with such reasonable precautions for preventing the spread of notifiable disease as may be required by the veterinary officer or inspector in charge of the area and also defines how the carcass of dead animal will be disposed. The details of Standard Operating Procedures (SOPs) are in the Rapid Response Protocol (RRP) document that is an annex of the Contingency Plan.

After confirmation of the preliminary diagnosis using rRT-PCR extended sanitary measures that include quarantine, movement control, delineation/zoning, culling, and markets closure as governed by the Animal Diseases Control Act Chapter 364 will be implemented by the Rapid Response Teams (see accompanying RRP document).

Avian influenza is readily transmitted via contaminated objects, so strict control of movement of materials that may have become contaminated with the virus and immediate imposition of tightly controlled quarantine on all places suspected of being infected are essential to a successful eradication programme. Ideally, a quarantine should be imposed on all farms/villages on which infection is either known or suspected and should be strictly policed to ensure that no one, including the residents, owners, staff and other visitors, leaves without changing clothes and footwear. Particular attention needs to be paid to workers on poultry farms who keep backyard poultry at home.

Strict on-farm biosecurity and hygiene is needed to control spread of the disease from wild birds. Access of wild birds to commercial poultry sheds and flocks should also be considered during depopulation operations. In areas where poultry are raised in a village environment, particular consideration needs to be given as to how effective quarantine, disposal and decontamination can be imposed.

Effective quarantine of an area requires around-the-clock security to ensure that only authorized personnel in protective clothing are allowed to enter. It will be necessary to supervise the movements of residents onto and off the property and to ensure that all pets are confined. It is also strongly recommended to ban cockfighting, pigeon racing and other avian concentrations in the outbreak area.

Quarantine and movement control in the epidemiological unit (EU) will be implemented as directed by the Director of Veterinary Services according to the Animal Disease Control Act, CAP 364 and any other appropriate sanitary measures. The disinfection of persons, materials, equipment and vehicles will be done according to the disinfection guidelines.

Upon confirmation of an outbreak of HPAI in the country, the DVS shall convene the Crisis Management Team (CMT) within the shortest time possible. The CMT shall mobilise the Rapid Response Team to travel to the outbreak area. At the same time, the CMT shall mobilise the local response team including the DVO, MoH, DC, local authority, local police boss and the animal service providers to travel to the outbreak area. The national and local rapid response teams will operate under the direction of the CMT to implement disease control measures according to the standard

operating guidelines of the Rapid Response Team that is detailed and enshrined in the National Rapid Response Protocol after consultation with the National Task Force.

The Department of Veterinary Services has an adequate personnel complement for deployment to respond to an initial and limited or moderate outbreak of HPAI.

A total of 24 technical personnel from headquarters, field stations and Regional Veterinary Investigation Laboratories (RVILs) have been identified and tasked to three Rapid Response Teams based at the headquarters.

The Department also has adequate personnel to man a further 5 backup RRT to be based at 4 RVILs and one district headquarter. The detail on the five (5) teams is as shown in Table 2:

Table 33 Kenyan avian influenza regional rapid response teams

No.	Rapid Response Teams	Site/location	Personnel
1	Mariakani RVIL	Mariakani	8
2	Nakuru RVIL	Nakuru	8
3	Eldoret RVIL	Eldoret	8
4	Kericho RVIL	Kericho	8
5	Busia	Busia	8
	Total		40

Source: Kenya avian influenza contingency plan, 2008

The Department of Veterinary Services as currently staffed may not be able to deploy trained technical personnel for response to multi-focal and wide spread incursions of HPAI. It is therefore envisaged that the DVS may co-opt competent professionals from other government and quasi-government institutions and the private sector for deployment to field and laboratory teams.

The Director of Veterinary Services should *a priori* execute a Memorandum of Understanding between the Permanent Secretary, Ministry of Livestock Development and the following institutions Kenya Agricultural Research Institute (KARI), National Veterinary Research Centre at Muguga, and the Biotechnology Centre in Kabete, University of Nairobi, College of Agriculture and Veterinary Sciences, Jomo Kenyatta University of Science and Technology, International Livestock Research Institute (ILRI), Kenya Veterinary Association (KVA), Kenya Association of Livestock Technicians (KALT), Egerton University, Kenya Livestock Technicians Associations (KELITA), Moi University and the National Youth Service.

External technical advice and cooperation will be requested from relevant organizations, namely FAO, CDC/USAID, AU-IBAR amongst others. The external organisations will provide technical, physical and financial resources.

In case of a wide spread disease infection that becomes endemic, other stakeholders will be called to help with various procedures. Therefore, non-health technical expertise and manpower will be necessary for pertinent activities like culling, disposal, quarantine enforcement and maintenance of public order. The National Disaster Operations Centre (NOC) of the Office of the President is a member of the National Task Force on Avian Influenza and is tasked with mobilizing both personnel and equipment necessary for the tasks mentioned above.

8.6.5 Regulatory systems and policy in the control of HPAI

Current policies, law and legal and regulatory systems related to the poultry sector and HPAI, such as those on Agriculture and livestock sector in particular, food safety, food production, food standardization, International trade, Environment and Transportation.

The poultry sector is governed by various rules and regulations on different aspects of the industry that include transportation, trade, environmental effects, food safety, production and others.

The poultry industry is poorly regulated and therefore constitutes a major challenge in the prevention and control of Notifiable Avian Influenza (NAI). Further, the current regulatory framework is not supportive of the poultry in terms of production, trade, marketing and processing of poultry and poultry products.

In view of the above, a study was commissioned by FAO and contracted to KVB to review and identify the gaps in the current laws, regulations and guidelines that regulate production, trade, disease control, public, welfare, processing, and safe consumption of poultry and poultry products, address the identified gaps to better facilitate the implementation the implementation of the control of NAI and other important diseases of domestic birds that include Newcastle disease and Infectious Bursal disease (Gumboro), develop rapid measures for addressing the legal gaps to support the implementation of NAI disease control strategies, including culling and compensation, review poultry import sanitary standards and regulations in view of the current global epidemiology of transboundary diseases of poultry and review and make recommendations for improvement of the wet markets for poultry. The study was also occasioned to review the regulatory framework to better allow for an effective disease control strategy for HPAI.

The study reviewed three principal statues, namely Animal Disease Act (Cap 364), the Meat Control Act (Cap 356) and the Prevention of Cruelty to Animal Act (Cap 360). Other acts that affect the poultry industry and were also reviewed, including the Feed and Fertilizers Act (CAP 345), and the Crop Production and Livestock Act (Cap 321). The KVB reviewed the regulatory framework and with the assistance of a legal expert developed appropriate draft rules that address the identified gaps.

At each point along the poultry value chain, the desired provisions for the control of NAI and other diseases were identified in relation to the existing provisions. Gaps were then identified and the appropriate provisions suggested. The act(s) and the appropriate sections(s) of the act(s) under which the gaps should be addressed were also identified.

In reference to feeds and feed safety and marketing, provisions for standards are provided for in Cap 345, section 3 and 4.

The draft rules are currently being reviewed by the DVS before they are presented to a wider stakeholder forum for discussion and endorsement. The final draft rules will be presented to the Director of Veterinary Services for further action including legislation and enforcement.

(a) Findings at various levels are as follows:

- The host is adequately included and defined as an animal in the three acts under the current provisions. The disease under Legal Notice No. 82 of 1996, CAP 364 declares HPAI as a Notifiable disease. Legal Notice No. 97 of 1998, CAP 364 bans importations of poultry and poultry products from countries reporting HPAI. The Meat Control Act (Cap 356) and Poultry Meat Inspection Regulations (E, 2 IV) include fowl plague.
- For disease reporting, quarantines and prophylaxis disease control farmers are compelled by Cap 364 to report suspect diseased animals to a veterinary or administrative officer and that the veterinary officer shall notify the Director of Veterinary Services who shall restrict movement.
- Hatchery rules (Legal Notice No. 47 of 1985) and 10, Cap 364 are in place but inadequate.
- In Cap 364, Bird rules No. 12 provides that imported birds should be accompanied by a veterinary certificate indicating that the source of the birds is free of infectious and contagious diseases. Rule No. 3 of the same Cap provides for a breeder to certify that breeding birds and eggs for hatching purposes are free of bacillary white diarrhoea, fowl paralysis and tuberculosis. Further to the earlier two rules, rule No. 4 of Cap 354 provides for ports of entry as only Mombasa, Nairobi and Kisumu.
- Currently, there is no regulation in reference to commercial production systems that is mainly in the major urban and peri-urban areas, there are no regulations even though the Animal Disease rules No. 4 provides that the DVS can control rearing of animals in urban areas, the rule does not include birds.
- Free range chicken production systems are reared in very close contact with man and wild birds. This also poses a great risk to infection and transmission of avian influenza.
- Stamping out/slaughter and disposal is provided for in Cap 364, Section 10 for the DVS to order the slaughter of animals for disease control purposes so that the DVS/VO/inspector may deal with the diseased animal in such a manner as he/she may deem necessary under Animal Disease rule No. 30. Decontamination with respect to animals and people is provided for under Cap 367, Section 7.
- Compensation for birds slaughtered for the purpose of disease control at a rate of Ksh. 150 and 200 for sick and healthy birds, respectively.
- Transportation of live birds and eggs is provided for under Cap 321, but does not include sanitary purposes that are discriminatory. The Stock Trader's Licensing Act has been repealed. Current provision in Cap 360 prohibits transportation of animals under cruel conditions. Cap 356, part 3 (i), e: The minister can legislate conditions under which animals intended for slaughter may be moved but are currently not operationalised. Regulations for movement of meat are adequately entrenched in the Meat Control Act (Cap 356). The cleanliness of live bird markets and sanitation premises where animals are held during transportation is provided for under Cap 364, Section 9, rule 47. The importation of live birds, meat and table eggs is provided for under the current provisions, Legal Notice No. 97 of 1998, Cap 364 bans importations of poultry products from countries reporting HPAI. Cap 364, (Animal diseases act) bird rules provide that imported birds shall be accompanied by a certificate of freedom from a number of diseases.
- Poultry slaughter and inspection have been provided for in the Meat Control Act. The establishment of slaughterhouses and the operational procedures, including the ante mortem examination procedures in relation to NAI, procedures for disposal of suspect/condemned materials, disposal of waste products is well catered for under the Meat Control Act.

8.6.6 Information and research gaps

(a) Regulatory framework

Several gaps that require attention were identified and documented during the study and includes the following.

1. The disease should be defined as NAI rather than HPAI, in accordance with OIE definition, to include highly pathogenic and low pathogenic Notifiable avian influenza. The suggestion is for the amendment of the relevant sections of the documents appropriately.
2. Farmers are not guided on what to consider a suspected disease and are not legally compelled to carry out prophylactic disease control measures. Provisional quarantines are also not formalised. It is therefore recommended that some acts (Cap 364) should be amended and new rules made under section 9 of Cap 364. Vaccinations against Newcastle disease, Gumboro, Fowl typhoid and any others as directed by the DVS should be made regular, including for free range birds.
3. Breeding and farms/hatcheries
   - Permits to hatcheries should be before and not after construction to allow for inspection of hatchery sitting, design and construction
   - Disease control in breeding flock does not include monitoring for NAI
   - There is no limit to number of species a hatchery should deal with
   - No regulations on disposal of waste litter
   - No health requirements for employees

   In reference to the above gaps, the study findings suggested the institution of appropriate and strict disease control measures in place for all diseases at this level of the poultry production chain by amending various in Cap 365, Legal Notice No. 47 of 1985 i.e. hatchery rules (KVB, 2007). These measures include waste disposal, vaccinations, inspections, monitoring and surveillance activities.
4. In reference to importation of breeding materials, NAI is not among the diseases that a breeder must certify breeding birds and eggs as free from. Other ports of entry should be provided for. The study suggests that Rule No. 3 shall include NAI apart from Newcastle, Marek's, Gumboro, epidemic tremors, avian leukosis/osteopetrosis, duck virus hepatitis and enteritis and suck septicaemia. Rules number 12 and 23 should be read together. Rule No. 4 should also be expanded to include other ports of entry by air, sea and land. These ports include Lokichogio, Malaba, Busia, Usenge, Isebania, Namanga, Loitoktok, Taveta, Lunga Lunga, Lamu, Eldoret, Moyale, Mandera, Liboi, El Wak and Kilindini. The above listed ports should include any other ports of entry as mabe designated by the authorised officer.
5. The Disease control rules No. 44 is not very clear in the control of rearing of birds as for other livestock in urban areas. There is also no licensing of birds kept for any purpose. The rearing of poultry together with others species is still very common, a situation that aggravates the risk of avian influenza transmission as pigs are kept in some production system very close to poultry. It is therefore suggested that appropriate vermin proof poultry housing that is separate from other species and people should be made mandatory.
6. Currently, there are no regulations for the confinement of free range birds. It is therefore suggested that rules should be made under section 9 (a and b) of Cap 364 to provide for birds to not share housing with humans for roosting purposes and to empower the Director of Veterinary services to order confinement of birds in case of outbreaks of Notifiable diseases.
7. Currently, there are no provisions on recognition of poultry waste as animal feed. There are also no guidelines on treatment of poultry waste before being fed to other livestock and conditions for transportation of the waste outside poultry farms. It is suggested that poultry waste be gazetted as animal feed and should be transported in covered containers. It is also recommended that no poultry waste should be used as animal feed or moved from one farm to another unless treated by heating, drying, silaging or any other method as prescribed by the DVS. The same should apply for poultry waste intended for use as manure that should be composed and transported as for poultry waste for animal feed. This, therefore, means that the following

sections in Cap 345 should be amended to be in line with the recommendations from the study, section 2 (for gazettement as food stuff), introduce new rule under section 19, (1) to cater for treatment, introduce new rule under section 19, (1), (e and i) to cater for transport and covering and section 19, (1), (i) to cater for transportation of manure.

8. The methods of killing and disposal methods are not specified and documentation for slaughtered animals for the purpose of compensation is not provided for in Cap 364. It is suggested that humane methods of killing and disposal should be clarified. A schedule for slaughter records should be introduced to provide for the necessary details to cater for compensation.

9. The disinfection of buildings/premises and the restocking period are not provided for or specified respectively. A new rule under Cap 364, section 9 (h) and (i) is needed to provide for an amendment that defines infected premises and materials.

10. Valuation procedures for culled/slaughtered birds in case of disputes as to the compensation amount are cumbersome and unclear. It is recommended that compensation amounts for all species of animals killed for disease control and valuation methods are provided for and clarified i.e. Cap 364, Section 12.

11. There is no provision for a movement permit in respect of birds under Cap 364 and therefore no sanitary regulation for transportation of birds. It is suggested that animal transportation under Cap 321 with the same rules under Cap 364 should be harmonised. Discriminatory terminologies in crop and livestock production acts should be repealed. Cap 364, Rule 15 on animal diseases needs to be amended to include the meaning of animals to include birds to allow for sanitary permits for poultry transportation. Eggs should be transported in covered containers unlike the current situation where it is always done in the open. There are no standards for transportation of poultry. Therefore, regulations are needed that prohibit transportation of birds in public service vehicles and also in the same compartment with humans in private vehicles. There should be container specification and also transport birds in lieu of the OIE welfare standards (no fear, stress, physical and thermal discomfort, pain, injury and disease). Therefore, Cap 360, Section 37 © should be amended. Live bird markets are not regulated. It is therefore suggested that live bird markets should be sited in designated areas, i.e. away from markets selling other farm produce. The markets should also feature a bird proof perimeter fence with a gate, disinfection footbaths, bird cages and a waste/carcass disposal facilities. The market operators should also keep records of origin, numbers, sellers and movement permits. It is also recommended that different compartment should be set a side for different species. Terminal markets shall feature slaughter facilities that conform to the requirements of local slaughterhouses. Animal welfare rights must be observed. The roadside sale of birds should be outlawed. The latter practise is very common along the major highways linking different parts of the country and also in Nairobi and its environs. The DVS should enforce the standards. Therefore, Cap 364, Section 9 rule 47 should be amended. There is a need to ensure that imported birds are accompanied by a certificate of freedom from NAI but currently, there is no mention of NAI in the bird rules. Part 3 (d) should be inserted to provide that birds are accompanied by a certificate of freedom from NAI. Thus, Cap 364, bird rules, 3 should be amended. It is further recommended that import permits should be furnished to a port of entry officer.

12. There are conflicts between CAP 242 and 356 resulting in the double application of rules. Meat inspected under Cap 242 reports are not available to the DVS, leading to loss of valuable data. There is also no provision for separation of poultry species before slaughter. It is therefore suggested that nomenclature of the diseases inspected for in schedule (e) rule 2 Sub rule iv be updated. According to OIE, include NAI (fowl plague) and the double listing of Newcastle disease should be removed. In the Meat Control Act (Poultry Meat Section): schedule (d), rule 7 and 8; bacteriological examination should be changed to microbiological examination. It is also

suggested that different species of birds are separated while awaiting slaughter. Other recommendations include the provision of incentives to private developers constructing slaughterhouses i.e. the provisions in Cap 242 should be removed and dichotomy resolved. The National Food Safety Committee should oversee all related issues and harmonise them in due course. Therefore, Caps 242 and 356 should be amended. There is no provision for treatment of feathers before they leave the slaughterhouse. It is recommended that all feathers should be treated before they are released from the slaughterhouse. Under import rules, feathers should come from areas free from all Notifiable diseases. The relevant acts should be amended to cater for treatment of feathers and Legal Notice No. 97 of 1998, Cap 364 banning importations from countries reporting HPAI to include feathers.

(b) Country level organisation for avian influenza management

The country institutional response capacity is weak but not appropriately documented. This is exacerbated by the weak linkages amongst various stakeholders in disease control. Therefore, there is a need for field studies to be able to determine the delivery mechanisms in response to outbreaks and recommend ways to improve them. Despite attempts to have the appropriate response strategies, the level of veterinary services is wanting. The institutional set up (DVS) is very weak in terms of human, equipment and physical resources. The linkages between the local disease control teams and the national level is also very weak. Lack of human resources greatly affects veterinary extension services that are key to the transfer of messages to the key stakeholders at the local level that include farmers, traders and local authority staff. Incentives for reporting diseases is lacking, as farmers are used to the "normal high, routine and regular" mortalities in poultry especially the domestic chicken. Despite reports by farmers, response from the animal health service providers is a common scenario. Therefore, there is an urgent need to incorporate holistic disease control measures to these commonly occurring diseases, i.e. ND, Fowl typhoid and Gumboro, so that farmers are able to realize the benefits of disease reporting.

9. Risk assessment

9.1 Background

The epidemiological situation of HPAI is evolving and is very dynamic globally. It is therefore necessary to improve on the epidemiological knowledge in reference to the entry, transmission and the consequences of the disease, hence need for risk analysis. This scenario necessitates risk analysis that results in prioritisation of epidemio-surveillance in all the poultry sectors in reference to the various risk factors. Risk analysis has led to the qualitative descriptions of risks in different biological systems in different parts of the country as low, medium and high in reference to the possibilities of the HPAI virus entry, dissemination and potential consequences. This necessitates carrying out the three stages of risk assessment that is briefly outlined below.

9.1.1 Release assessment

There are several important factors that include biological, country and commodity factors that influence the introduction of HPAI into Kenya and include:

(a) Trade (legal and illegal imports)

Trade is a potential risk factor that facilitates the entry of HPAI, as the status of the disease in the neighbouring countries is not well documented. To mitigate the potential risks, emphasis should be put on the importance of implementing and maintenance of appropriate enforcement of control measures at the ports of entry. This is both for live domestic birds including day old chicks, pets, game birds, poultry products and livestock feeds. Porous borders increase the chances of disease entry. There are very many un-official entry routes that could exacerbate the entry of HPAI into Kenya along the whole length of the Kenyan border with its neighbours.

(b) Mechanical transmission

As is the case with other new and emerging diseases, there is a significant likelihood of mechanical transfer after visiting areas where outbreaks have occurred.

(c) Wild bird migration

The role of both migratory and resident wild birds in the transmission of the disease to domestic poultry in Kenya is still not very clear but there is a chance of entry through this mode. Kenya lies on the main international wild bird migratory flyway from North to South.

(d) Animal demographics

This is represented by the huge indigenous and commercial poultry production systems that are highly susceptible to the virus and widely distributed in the country (i.e. sectors 3 and 4, FAO classification).

(e) Geographical and environmental factors

Climatic factors that favour high humidity and temperatures act to sustain the virus for long periods , hence exposing the birds to risk of infection. The presence of several lakes along the wild bird flyways adds to the risk of virus being introduced into the domestic poultry.

(f) Contamination

The risk of contamination is very high especially during the transportation and processing of poultry and poultry products destined for the urban markets.

(g) Veterinary Services

The level and effectiveness of inspection at all the ports of entry and border points directly affect the probability of disease entry.

9.1.2 Exposure assessment

It is important to describe the biological pathways that are necessary for exposure of animals within Kenya. This is important in estimating the likelihood of exposure occurring and being disseminated. In Kenya, various biological, country and commodity factors are important during exposure assessment and could potentially contribute to the spread and transmission of infection following introduction into the country. They include the following:

1. Unsatisfactory levels of bio-security along the poultry value chain (production to consumption).
2. Production system (this is exemplified by the sector 4 system that is not confined with mixed species being reared together with non-existent or very poor bio-security and sector 3 that shows poor biosecurity measures).
3. Complex marketing chains (involves exchange of poultry from the farms through middle men and finally sold at the live markets especially for the indigenous chicken).
4. Transport mode (chicken at times carried in the same vehicles with humans, chicken also transported by being carried using carts, bicycles and open vehicles that are not secured against dissemination and are never disinfected. This mode of transport could facilitate the transmission of the hazard very fast).
5. Quality of inspection of poultry processing (monitoring and surveillance).
6. Presence of wetlands (influences migration patterns).
7. Interactions between domestic resident and migratory wild birds that mix freely with domestic poultry especially the sector 4 category.
8. Mechanical transmission (as for release assessment).
9. High human population and cultural factors (birds are confined at night in the same houses with humans in many parts of the country).

9.1.3 Consequence assessment

It is also important to understand and study the consequence of the disease as a significant component of risk analysis that involves estimating the likelihood of the occurrence of the direct and indirect consequences and effects of the disease that include the following:

1. Outcome of exposure in domestic poultry populations leads to loss of livelihood and food security (morbidity, mortality and production losses).
2. Environmental consequences such as the side effects of control measures.
3. Economic considerations (compensation, control, eradication, monitoring and surveillance costs).
4. Public health consequences.
5. Other side effects such as losses of tourism earnings.

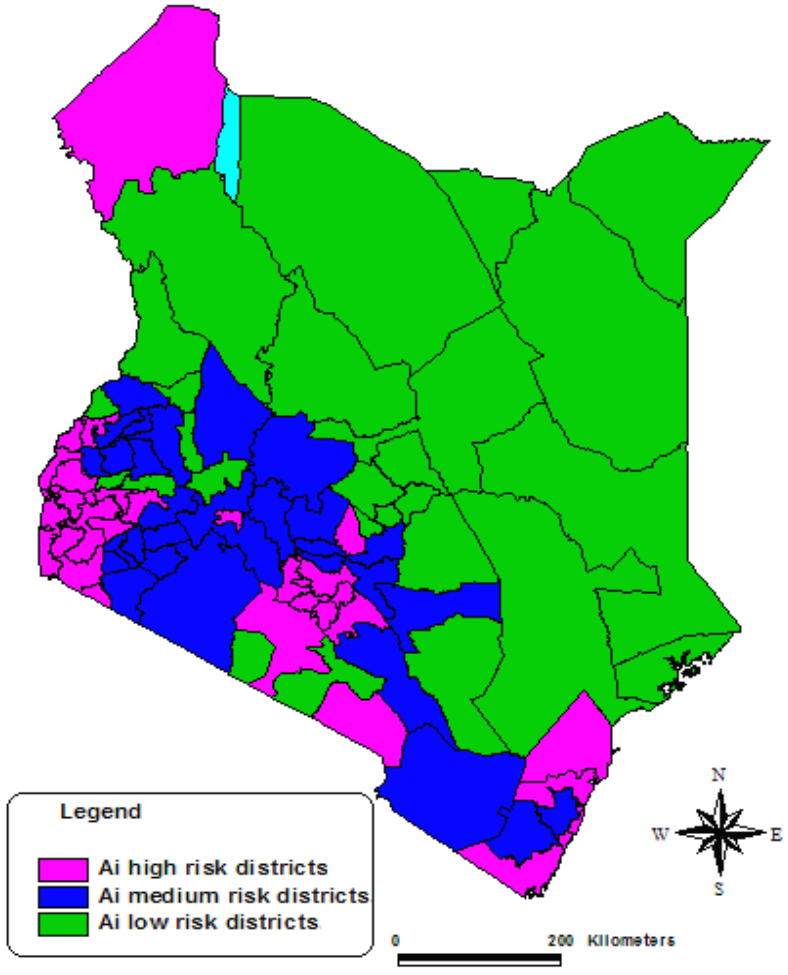
After understanding and studying the likelihood of the disease introduction, transmission and consequences, it is important to document the ability of the country to carry out and document risk management based on appropriate sanitary measures. The factors to be considered for the Kenyan situation are prompt detection (reporting, diagnosis = early warning), rapid response (communication and action) and resources (personnel, physical/equipment and finance).

The areas at greatest risk in Kenya are ports of entry (airports and ports), wetlands and border points. The domestic poultry production systems that are under the greatest threats from HPAI are sectors 3 and 4 those that have poor biosecurity measures, as opposed to sectors 2 and 1 that are relatively biosecure. Means of transport and marketing routes worsen the situation. Based on the factors that are listed earlier, a new avian influenza risk map has been produced (Figure 17).

9.2 Risk assessment studies carried out

Risk assessment studies have been carried out by the FAO project on early detection, prevention and control of avian influenza in Kenya in collaboration with the Department of Veterinary Services. The study was a qualitative risk assessment carried through a field study that was carried out by conducting key informant interviews and surveys along the poultry production, marketing and consumption chain. The field risk assessment was carried out after a thorough study of secondary literature from district veterinary and livestock reports from majority of the current 149 districts In Kenya (Mutai, Ouko, Mokua and Munyoki, personal communication). The reports were submitted by the participants in the trainings from various districts in the country of varying risks to avian influenza incursion.

Figure 17 New avian influenza risk map by district for Kenya



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entry into the country at will especially at the "*panya*" routes (porous border points) and also designated entry points that include Malaba, Busia, Sio Port, Muhuru bay, Isebania, Namanga, Loitoktok, Taveta and Lunga Lunga. Eggs pass along the borders in large numbers into the country without any veterinary certificate from countries of origin. The chance of disease entry is exacerbated by the low biosecurity in the free range poultry production system as found out during the release assessment. This is worsened by the mixed poultry production system of chicken (mainly indigenous), ducks, geese, guinea fowls, quails and pheasants. The chance of disease transmission as found out from the exposure assessment is also very high because of the nature of marketing system, slaughter, weak strength of the veterinary services and poor law enforcement by the relevant authorities. The consequence assessment also indicated that the impact of the disease will be very high in case of avian influenza incursion as the emergency preparedness might be overwhelmed by wide spread avian influenza outbreaks.

The vigilance at the airports (Jomo Kenyatta International Airport, Nairobi and Moi International Airport, Mombasa) is better as there are veterinary officers who man these ports of entry. The inspection is inadequate as the ports of entry are not manned for 24 hours although flights are on 24 hours schedule. Eldoret International airport, which receives a lot of cargo (Martin, personal communication), has no veterinarian/inspector assigned to inspect incoming goods of animal origin. This poses a great risk of avian influenza introduction from poultry products that have been incriminated transmission of the disease. The same risk is also found at the other two airports that receive flights from outside the country that are Wilson and Lokichogio airports. Vigilance at the Kilindini harbour is much better as it is manned by a VO who has been able to detain,confiscate and re-export some chicken products from South East Asia and Egypt in the past from 2005 to 2007 (Ouko, 2007, Munyoki, 2007). The products that pass through the Kilindini harbour and Moi International Airport include chicken soup and cubes from Egypt that were re-exported in December 2006, artificial chicken noodles from Thailand, China and Korea, artificial chicken rings from Malaysia, yolk powder from China and cakes/biscuits from China and Korea and other assorted foods and flavours from different countries. Other poultry and poultry products that pass through JKIA include hatching eggs into the country and on transit to other countries like Tanzania, Uganda, Burundi, day old chicks, egg powder, live turkeys from UK, DOCs, parrots and frozen ducks.

In summary, the risk of incursion of avian influenza into the country can be described and summarized as negligible to low considering the current internal and external epidemiological situations in and outside of Kenya and all the factors that facilitate the introduction of the disease (Rotich and Maswage, personal communication). This is because the disease outbreak that was reported in Sudan in 2006 has been contained and no case has been reported in all the other neighbouring countries, i.e. Uganda, Tanzania, Ethiopia and Somalia. The importation of poultry and poultry products has been banned from countries that have reported avian influenza. This minimises the chances of the disease entering into the country today, despite the high chances found during the exposure and consequence assessments at various levels of the poultry production-marketing-consumption chain.

Potential differential pathways of introduction into the country could be through eggs, day old chicks, and other poultry products like chicken noodles and powered chicken soup.

9.3 Research and information gaps

In reference to risk assessment the following gaps have been identified.

(a) Eradication of the disease is made difficult as it is militated against by attempting control in the reservoir species. Thus, there is a need to shift the control strategy to a more long term approach in prevention and control. This calls for studies on the level of interface/interaction between humans and poultry. Therefore, assessments on the levels of biosecurity that are a major proponent in the management of the disease should be carried out.

(b) The country lacks documented risk assessments (release, exposure and consequent) carried out at various points along the poultry value chain that would help in the management of avian influenza through effective communication. The lack of this important information results in indecision in applying appropriate disease control strategies. Studies should be carried out to better mitigate the consequences of the disease.

(c) Effective information, Education and Communication (IEC) is considered an essential ingredient in avian influenza control. Risk assessment studies carried out indicate that key stakeholders in the control of avian influenza, which includes customs officers, local authorities' staff, law enforcers and traders are not aware of the risks associated with the disease in reference to human health and sustainable livelihoods. This difficulty in effective risk communication is attributed to diversity in literacy, tradition, culture and the level and quality of veterinary service provision. This, therefore, calls for studies to understand the real reasons for poor communication and ways on how to bridge the gaps.

(d) The poor IEC component of mitigation measures against avian influenza is compounded by lack of information material that is readily available to all stakeholders. This is a gap that should be looked into so that indigenous approaches can be used as a way of passing the right information effectively and efficiently.

10. Conclusions

This study documented available information on the poultry sector. The objective was to identify knowledge gaps that HPAI research in Kenya should focus on. A thorough review of existing literature was done including searches over the internet. The study found that Kenya had about 37 million birds in 2006 of which 84.1% were free-ranging indigenous birds, 8.4% were layers, 5.7% were broilers while other poultry species accounted for the other 1.8%. About 65% of the Kenyan households keep chickens; each household keeps about 12 chickens on average. Poultry are produced in four main production systems – which were labelled Sectors 1-4. Sector 1 consists of the integrated industrial producers (big companies), Sector 2 is made up of hatcheries, Sector 3 is dominated by smallholder semi-commercial farmers while Sector 4 constitutes the village or traditional poultry production system. The September 2005 HPAI scarce led to a loss of about Ksh 2.3 billion mainly due to reduced demand for poultry products as consumers shunned away those products. Significant gaps in knowledge still remain. For instance, research is needed to understand how to design appropriate compensatory mechanisms to cushion poultry producers and businesses from losses due to the disease. In addition, there is a need to evaluate the appropriateness of existing alternative control measures as well as their cost-effectiveness in HPAI control.

Based on these findings, the study recommends the following:

- There is a need to conduct a poultry population census (possibly together with that of other livestock species) in order to update and validate existing data.
- There is a need to create awareness of HPAI among producers and consumers of poultry products in order to reduce their ignorance on the disease transmission and therefore avert possible losses due to an HPAI scare.
- Compensatory mechanisms should be instituted, possibly through poultry insurance schemes in order to cushion farmers and businesses in the poultry sector from economic losses associated with an HPAI outbreak or scare of and outbreak.
- The veterinary department should come up with clear guidelines on the appropriate control approaches for the disease (e.g. vaccination and compensation policy).
- Risk assessment studies should be carried by the DVS as a component of an early warning system to make the risk based surveillance system comprehensive.

The following categories of gaps were identified:

a) Information gaps

There is a lack of accurate data on the number of poultry in different sectors and people keeping poultry, volume and value and flow of poultry and poultry products along the marketing channels and proportions of poultry from different sectors that enter into the wet market system constrain planning within the sector. Unavailable information can be captured through studies that could also capture the social and economic differences that characterize the production system.

The impacts of the HPAI scare in Kenya were highly publicised on various types of media but no concrete data on businesses that were affected is documented. No mention was made on the potential costs of culling and compensation during the scare. This is very important and will give insight to the magnitude of the impact of the disease in Kenya. Losses along the poultry value chain are reported but no documented data is available.

There is also a lack of information on breeding practices and sources of different breeding materials in the backyard systems. Lack of information on the role of private animal health service provides also constraints disease reporting. There is not much documented proof of this data despite its importance in early detection of the HPAI.

All the information gaps should be identified and complemented by assessment of knowledge, attitude and perception (KAP) of producers and other actors on disease risk and control measures. All this should be followed by developing appropriate biosecurity packages for each poultry production sector.

b) Research gaps

Socio-economic research is needed despite the baseline information that has been captured by Kimani et al (2006) in different poultry production systems with respect to the avian influenza threat. More research is also needed to design appropriate and acceptable compensation mechanisms to avoid problems and conflicts that have been experienced in other countries during HPAI outbreaks. Other elements of socio-economic research calls for work studying the cost-effectiveness of alternative disease control measures and identifying the costs and benefits of these measures in different socio-economic groups in Kenya.

Research is also needed on early warning systems, an essential tool in the management of avian influenza, a highly infectious disease. This work should be accompanied by structured studies on the prevalence of major poultry diseases (Newcastle disease, gumboro and fowl typhoid) that will give adequate data to plan and design relevant disease control strategies including avian influenza. Exhaustive wild birds deaths that have been carried out in various parts of the country should be undertaken. Identification of the potential channels of disease entry and spread should be studied. Pathways for each channel should also be studied and documented. Risk factors that cause endemicity of avian influenza and Newcastle disease should be exhaustively researched. The current poultry vaccination programmes and disease control measures of the major poultry diseases, i.e. Newcastle disease, fowl typhoid and gumboro, should be assessed. These results can then be used as entry points for improving biosecurity measures and therefore act as measures to contain avian influenza indirectly. The efficiency of current gumboro strains used in the country should also be assessed together with the characterization of various strains of the gumboro disease virus. All the work on disease control should also be accompanied by estimating the cost-benefit analysis on disease control measures, e.g. for Newcastle disease and gumboro,

There is an urgent need to study and document the institutional response capacity and linkages amongst various stakeholders. This is very important in disease reporting and general management of avian influenza.

c) Biosecurity issues

Bio-exclusion and bio-containment are a key features in the control of avian influenza. Information on the quantities of manure produced from the intensive systems, current disposal and utilization methods should be documented to guide the planning of appropriate biosecurity measures. Other issues related to biosecurity that are important in the management of avian influenza that have not been appropriately studied or documented include identification and quantification of all actors in the informal sector and quantifying all hatcheries in reference to their status and performance

especially for village based traditional hatcheries. In view of the above, a quantitative bio-security assessment of each poultry system is needed.

Routine animal and husbandry practices carried out in different sectors, ethno-veterinary practices and vaccination coverage in the backyard system have not been appropriately documented. This documentation should be complemented by getting information on feed millers, processors and their levels of integration and different methods of transportation of DOCs and live birds. The current manure and by-products (gizzards, legs and necks) disposal should also be assessed to complete the chain biosecurity assessment.

d) Regulatory and institutional framework

The poultry sector is poorly regulated all along the value chain. This constitutes a major challenge in the management of avian influenza. There are various gaps and deficiencies that include the re-definition of HPAI as NAI, the lack of appropriate acts for breeding farms and hatcheries, the lack of clarity on various disease control acts, no provision for permit for movement of birds in Cap 364, no regulations for confinement of birds, no specification of killing and disposal guidelines in the law, no disinfection and restocking guidelines in the current acts and various conflicts between different disease control acts. All these gaps should be looked into expeditiously to improve on avian influenza management.

The above studies should be complemented by studies on the partnerships between private and public veterinary sectors that should be strengthened for improved disease reporting, surveillance, information dissemination and funding. Other studies in this theme include modelling to facilitate the restructuring of each poultry sector, developing a framework for the poultry production sector in relation to regulatory framework and an information sharing model across the stakeholders on surveillance, reporting and early warning.

ANNEX 1. Annotated bibliography of key literature

No.	Year	Reference	Subject	Summary and assessment of value of information
1.	2008	Potential Socio-economic impacts of avian influenza and a compensation strategy for its control in Kenya. By Director KARI. Submitted to FAO and DVS to Project OSRO-KEN-601-UK. Report compiled by Mulinge W, Wachira A, Ngotho R, Kimani T, Maingi P, Murithi F, Wamae L and Maina O .	Socio - economics	A consultancy report compiled by KARI to FAO on the potential socio-economics assessment of avian influenza as a planning basis for improved HPAI prevention and control in case of an incursion in Kenya. The recommendations from the study to prevent, control and eliminate the virus are effective disease surveillance for early detection of outbreaks, enhanced bio-security of poultry farms and associated premises, control of movements of birds, changes to industry to reduce risk, rapid destruction of infected poultry, disposal of carcasses in a bio-secure and environmentally acceptable manner, the proper use of vaccination, speed and simplicity of implementation to ensure that poultry owners cooperate and that quick eradication of an incursion is achieved, availability of resources should be ensured, procedures and logistics for compensation, need for strategic communication to keep all stakeholders informed, ways of preventing collapse should be identified and implanted prior to and during the outbreak, adopt a producer friendly compensation strategy for culled birds and appropriate measures for rehabilitation
2.	2006	Draft paper on National Livestock policy. Republic of Kenya. Ministry of Livestock and Fisheries Development	Livestock policy	A collection of various consultations among stakeholders that convened to review policy. Addresses the challenges and shortcomings arising from liberalisation policies effected by the government in the 1990s.The document is consistent with strategies that that are stipulated in the Economic Recovery Strategy (ERS) for Wealth and Employment Creation and the sector wide Strategy for Revitalizing of Agriculture (SRA).
3.	2007	The structure, marketing and importance of commercial and village based poultry in Kenya. Poultry Review – Kenya. Food and Agriculture Organisation of the United Nations. Consultant Prof. P.N. Nyaga.	Poultry	A consultancy report that reviewed the status and development of production systems in Kenya. This was carried out by interviewing various stakeholders involved in the poultry industry and visiting representative farms and other poultry operations in all the sectors.

		Nairobi August 2007.		
4.		Livelihood Study among Migrants (poultry transporters, traders and handlers) in Kenya. By Muthoni Mwangi, Stephen Gikonyo and Rosemary Chacha. Draft report 20 March 2008. Report to IOM.	Livelihood study	The study was designed to assess the impact of avian influenza outbreak on livelihood and food security among poultry and poultry products' transporters, traders and handlers in Kenya. The field study was carried out in Nairobi and Turkana amongst migrant communities. Literature review identified gaps in policy. Livestock movement directives as stipulated in Kenya's laws are openly flouted. The study recommended for capacity building of migrant communities on bio-security, transportation and handling of poultry and poultry products.
5.		The World Fact book. Central Intelligence Agency (CIA) (2008).	Surveillance and risk assessment	A report submitted to an outbreak investigation, surveillance and basic risk analysis training on avian influenza for public health service providers from Western, Nyanza and Rift Valley provinces. Training conducted by FAO – Kenya in collaboration with the Department of Veterinary Services from the 8th to the 10th of April 2008.
6.	2002	Department of Veterinary Services annual reports (2001-02)	Disease control activities	Annual report by the Department of Veterinary Services. This is a compilation of field reports from all districts in the country within the years 2001-02. The report gives a detailed summary on the annual activities and findings mainly on disease control.
7.	2005	Meat production in Kenya, 2005. Export Processing Authority. http://www.epzakenya.com/UserFiles/File/Fishkenya.pdf	General	Information provided in the report is intended to provide general information to investors. The website provides very useful information on the Kenyan meta industry by giving an industrial overview and structure in terms of livestock farming, supply, slaughter houses, animal feeds, meat production and market conditions and legal and regulatory frameworks that guide the meat industry. This is very useful information in terms of risk management and communication in reference to avian influenza.
8.	2008	Highly Pathogenic Avian Influenza Contingency Plan for Kenya	Disease control	Contingency plan for the management of avian influenza during different phases. The contingency plan was developed over a period of one year in a participatory by the Food and Agriculture Organisation and the Department of Veterinary Services in Kenya. The preparation involved wide and exhaustive stakeholder participation

				through workshops, trainings, meetings and informal discussions.
9.	2001	A survey of the disease status of village chicken in Kenya. Livestock Community and Environment. Proceedings of the 10th Conference of the Association of Institutions for Tropical Veterinary Medicine, Copenhagen, Denmark, 2001. By Njue, S.W., Kasiiti, J.L., Macharia M.J., Gacheru S.G. and Mbugua H.C.W.	Disease status of village chicken	The study was set out describe the main poultry diseases of village chickens in agro-ecological zones (AEZs) II and III located in two administrative areas of Kenya, with the aim of developing interventions that would improve production and hence livelihood of poultry rearers. The study was carried out for one year covering the dry and wet seasons using formal and informal interviews starting from October 1999.
10.	2002	Evaluating the effect of Newcastle disease control and improved feeding regime on productivity of village chickens in Kenya. Proceedings of 3rd Research Coordination Meeting of the joint FAO/IEEA., Mauritius 6th to 10th May 2002.By Njue, S.W., Kasiiti, J.L., Macharia M.J., Gacheru S.G. and Mbugua H.C.W.	Evaluation of Newcastle disease vaccination	The study was carried out from October 1999 for a period of one year using semi-structured interviews in six villages in AEZs II and III involving both village and commercial chicken. The study found out that the productivity of village chicken is likely to improve through better feeding regime and vaccination against Newcastle disease.
11.	2008	Formative Research on Avian Influenza, Kenya (Draft). February 2008. Funding provided by the Centers for Disease Control and Prevention (CDC). By Lauren S. Blum.	Formative research	The research was designed to assess present knowledge and risk perception of avian flu, traditional poultry raising techniques, and local slaughter and preparation of poultry. We also assessed appropriate reporting strategies of sick or dead poultry. Additional interviews were carried out with health workers to understand their knowledge of avian flu and information needs for future training purposes. The study also attempted to identify appropriate communication approaches and channels to use for future dissemination of messages. Results from the study will guide the development of a nationwide avian flu communication strategy designed to provide appropriate, practical recommendations to contain the spread of H5P1 among poultry and prevent human exposure.
12.	2006	Bird flu threat still over Kenya, by M. Githahu. Business Sunday (Sunday Nation	Communication	Newspaper report on avian influenza scare

		/ January 15 2006).		
13.	2002	Annual report. Department of Veterinary Services, Kenya.	General	Important in giving a picture on the disease situation and picture in the country. It also explains the disease prevention and control activities carried out by the Department of Veterinary services in the Ministry of Livestock and Fisheries Development
14.	1996-2007	Annual reports. Department of Livestock Production. Ministry of Livestock Development and Fisheries.	General	Gives an account of the livestock production situation in the country and gives estimates on different livestock populations.
15.	2001	Republic of Kenya (RoK) (2001). 1999 Population and Housing Census. *Volume I*, 415pp.	Census	The first volume gives an account of the human population in all parts of the country up to the lowest administrative level.
16.	2007.	Poultry and poultry products handled at Jomo Kenyatta International Airport. Paper presented at the Training on surveillance and Risk analsysis held at Garden Hotel, Machakos. Garden Hotel. Ouko, E.O. 10th to 12th July 2007.	General	The paper gives an account of poultry and poultry products that pass through the Jomo Kenyatta International Airport. It attempts to state the export and import destinations for all the stated materials.
17.	2008	Causes of mortality of Indigenous Chicken in smallholder farming systems in UASIN Gishu district, Kenya (in Press). Okuthe, O.S. Buyu, G.E.	Productivity assessment	A two longitudinal study carried out in Uasin Gishu district in the western Kenya highlands from 1996 to 1998. The study gives findings on poultry productivity parameters in indigenous / village chicken. It also gives an account of the disease management practices. A very useful document as it gives incidences on the major poultry diseases in the region.
18.	2007	Assessment of Kakelo Community Poultry Development Project in Rachuonyo District. Presented in partial fulfilment of the requirements of Masters of Arts Degree in Project Planning and	Evaluation	An evaluation of a poultry development project through a community based organisation in Kakelo, Rachuonyo District in collaboration with a Faith Based Organisation and the catholic church. This evaluation emphasises on the importance of poultry in food security and livelihood. The evaluation showed that poultry production is an important activity amongst smallholder poor farmers and could be

		Management. School of Environment and Earth Sciences. Maseno University. Odera, L.A., 2007.		used as an approach for poverty alleviation.
19.	2008	Central Intelligence Agency (CIA) (2008). The World Factbook. https://www.cia.gov/library/publications/the-world-factbook/geos/ke.html	General	Provides country-specific information of different aspects-political, economic and social. It is regularly updated and is useful to a general reader.
20.	2008	Keiyo district report. Avian influenza outbreak training in Kakamega from the 8th to the 10th 2008 implemented by Food and Agriculture Organisation and the Department of Veterinary Services. Chege Munderu, 2008.	General	The report details the surveillance activities in Keiyo district for part of the year 2008. The report has details on the major livestock diseases with emphasis on poultry. The distribution of wet lands is covered in great details in the document. This gives a good indication on where to find both resident and migratory wild birds in the area.
21.	2007	Highly pathogenic avian influenza: A rapid assessment of the socio-economic impact on vulnerable households in Egypt. Food and Agriculture Organization of the United Nations, Rome, 78pp. Geerlings, E. (2007).	General	This is work commissioned to look into the Socio-economic impact of avian influenza in Egypt. The work reports on the effect of the disease on livelihood, food security and public health issues. The disease also had an effect on the functioning of the veterinary services in various sparts of the country. It is a very useful paper that outlines experiences in a country where the disease is currently endemic hence leading to difficulties in the management of the disease.
22.	2007	Response to the Threat of Avian Flu in Developing Countries: Preliminary Assessment of Lessons Learned on Control and Protecting Livelihoods. Final Draft Report. International Livestock Research Institute, Nairobi, 84pp. ILRI (2007).	General to AI research	This report details on the threat of avian flu in the developing countries. It gives country specific reports on research gaps through various stakeholder discussions and case study reports. The discussions were very participatory, hence a good information sharing amongst different countries at various stages of economic development.
23.	2000	The Bangladesh model and other experiences in family poultry	General	A field study on the status of village chicken was carried out in Nyando district in the Republic of Kenya to document flock characteristics, management methods,

		development: Commercialising rearing of village chicken. A paper presented in the International Network for Family Poultry Development (INFPD) symposium in Montreal, Canada, August 24th 2000. Kaudia, T.J., and Kitalyi.		and identify constraints and opportunities in rearing village chicken in the area. Village chickens are reared under scavenging systems mainly as a source of income and food. Flock population per household was 24.2 chicken with 50% chicks and hen to cock ratio of 2.6 to 1. Good productive hens lay an average of 15.4 eggs having 3.1 clutches per year and a hatchability of 87.5%. However, chick mortality at weaning after three months is high at 62.4%. Main causes of chick mortality are disease and predators. Chicks take 6 months to attain market weight of about 1.2 kg. Most of the farmers apply no specific techniques to boost production. Women own, manage, sell and receive money from chicken sales in most of the households. Constraints to rearing chicken are disease, predators, poor housing, poor management and lack of feed, low market prices and lack of markets. It was concluded that the potential for village chicken as a source of wealth and development, promotion of gender equity and poverty alleviation is enormous and can be harnessed by training farmers, improving management and marketing systems.
24.	2005	Focus on livestock sector: Supply policy framework strategies status and links with value addition. A paper resented at a workshop on value asses food & export investment. The Grand Regency Hotel, Nairobi on 3rd March 2005, 11pp. Kiptarus, J.K. (2005).	General	The paper provides information on policy and frame works during value addition of various livestock products. Value addition in poultry production must be regulated by various rules and regulation, some of which are lacking and should be formulated. The value addition also touches on various aspects of bio-security that is very important in the management of especially Animal human influenza infections.
25.	2004	Pathways out of poverty in Western Kenya and role of livestock. PPLPI Working Paper No. 14. International Livestock Research Institute and Food and Agriculture Organization of the United Nations (A Living from Livestock), 29pp. Kristjanson, P., Krishna, A., Radeny, M. and Nindo, W.	General	This was a study carried out in western Kenya in Siaya and Vihiga districts. The objectives were to obtain a better understanding of household pathways into, and out of poverty, with poverty defined from the communities' own perspective. The work was carried out in 1,700 households in the two districts representing two different ethnic groups in Western Kenya. The proportion of households that had managed to escape poverty over the last 25 years was ascertained, as well as the proportion of households that had fallen into poverty during the same period. The

		(2004).		Major reasons for movements into or out of poverty were elicited at both the community and household – level, and in particular, the role that livestock play in the different pathways was examined. The study findings indicated that small stock that include sheep, goats and poultry are important safety nets that are required by poor households to help protect the health and improvement of the education of community members. This shows that chicken is important in poverty and any condition that affects poultry health like avian influenza will exacerbate poverty further, a situation that should be avoided at all costs.
26.	2005	Value chain analysis and indigenous poultry sub sector, Kilifi and Kwale district, Kenya. Final report. Mathuva, J. M., 2005.	General	This study that was carried out in Kwale distinct indicated that bio-security measures along the poultry value chain are an issue that should be tackled as it was very poor in various levels along the chain. The study also elaborates on the various players along the chain. This is an important finding as bio-security is one of the most important containment measures in the control of avian influenza. It is important to net-work amongst the various players to be able to manage the avian influenza problem during scares or outbreaks.
27.	2003	Ducks in rural and semi-urban poultry production. A paper presented at a national workshop on "Use of Research Results in the Development of Smallholder Poultry Projects," held at ILRI, Nairobi, Kenya, on 29th–30th October, 2003. Mbuthia, P.G., Nyaga P. N, Bebora L. C., Njagi L. W., Minga U., and J. E. Olsen.	General	The study characterise duck in rural and semi-urban set ups. This is a very important finding that gives information on bio-security measures and management practices in duck production. The findings are important as the information will be used in targeted surveillance of this high risk species that is important in shedding HPAI virus without showing any clinical signs.
28.	2007	Low plasma vitamin B-12 in Kenyan school children is highly prevalent and improved by supplemental animal source foods. *The*	General	The study findings emphasise on the role of poultry in providing the much required proteins for Kenyan school children

		Journal of Nutrition, 137:676–682. McLean, E.D., Allen, L.H., Neumann, C.G., Peerson, J.M., Siekmann, J.H., Murphy, S.P., Bwibo, N.O. and Demment, M.W. (2007).		The role of chicken is important and any threat from avian influenza will have far reaching consequences on the community in various parts of the country.
29.	2002	Credit and investment in urban agriculture in Nairobi City, Kenya. Mireri, C. 2002.	General	This gives information on the investments levels in urban agriculture. Poultry farming is the major occupation for most of the urban farmers especially those in sectors 3 and 4 where it contributes a lot to livelihoods and food security.
30.	2007	Annual report for surveillance at Kilindini port. Report to Avian Influenza Training on surveillance and Risk analsysis held at Garden Hotel, Machakos. Garden Hotel. 10th to 12th July 2007. Munyoki, G.M.	General	Annual report on the activities carried out by the Department of Veterinary Services at the port of Mombasa, Kilindini harbour and the Moi International airports. The report gives an account of the poultry and poultry by products imported into the country. It also gives the quantities of suspect products that were tested and either re-exported or allowed into the country.
31.	2000	A research process and methodology focusing on indigenous Kenyan chickens: Paper presented at the International Network for Family Poultry Development (INFPD) symposium during the XXI. World Poultry Congress in Montreal, Canada, August 20 to 24, 2000. Ndegwa, J.M., Norrish, P., Mead, R., Wachira, A.M.2000.	General	Indigenous chickens are among the local assets of poor people living mainly in rural areas and who make up between 65 and 80% of total population in sub-Saharan Africa. Over 90 % of rural households keep and rear chicken in small flocks of about 20 birds. Not until quite recently, there hardly had been any meaningful investment in harnessing this valuable resource as means to alleviate pervasive indigence. Productivity of these birds has therefore been discouragingly very low. Bearing in mind that indigenous chickens comprise of close to 80% of total poultry population, ample investment in research and development in this sector then, is indeed a matter of great importance and for urgent consideration. The paper explores a research process and methodology carried out over a period of time as an attempt to mainstream indigenous chicken sector in the research and development agenda. There is also the stressing on its potential in contributing to development of sustainable livelihoods and poverty eradication among the poor, often marginalised section of the population, majority of who are rural women. The study emphasises the role of poultry in sustainable livelihoods and food security

				and therefore the need to prevent any disease e.g. avian influenza or productivity constraint that might affect the rural poor especially women who are the major players in sectors 3 and 4 systems.
32.	2005	Productivity and socio-cultural aspects of local poultry phenotypes in coastal Kenya. Unpublished MSc thesis, The Royal Veterinary and Agricultural University, Denmark, 98pp. Njenga, S.K. (2005).	Productivity and socio-cultural	The paper describes productivity and socio-cultural values of various poultry phenotypes in the coastal area of Kenya. This is an important study that describes the physical appearance and characterisation of different poultry in this part of Kenya.
33.	2000	Smallholder Poultry Production in Kenya, In Pedersen G., Permin A., Minga M. U. (Eds): Proceedings of the Workshop on the Possibilities for Smallholder Poultry Projects in Eastern and Southern Africa, Morogoro, Tanzania, Network for Smallholder Poultry Development, Denmark, Pg 31-40. Nyange R. K. (2000)	General	A study was conducted to characterise existing rural smallholder poultry marketing systems in four villages of Malingunde Extension Planning Area (EPA) in Lilongwe West Rural Development Project (RDP) in Malawi. 147 households were selected through a two - stage cluster sampling procedure from Ishmael, Mankhanga, Sinyala and Kalonga II villages. A survey was done to determine market players, marketing channels, household selling decisions and marketing margins. The major constraints in rural chicken marketing were identified as low prices (72.0% of the respondents), low marketable output (57.3% of respondents) and long distances to reliable markets (26.6% of the respondents). Farmers' decision to sell chickens was significantly affected by the source of chickens sold and the number of chickens lost. The study also showed that there are three main frequently used chicken marketing channels as follows: 1) direct producer to consumer selling (PC channel); 2) rural assembler selling to retailers for final selling to consumers (RA-R channel) and 3) assembler-retailer (AR channel) where assembly and retailing functions were integrated. The total channel margin generated as a proportion of the producer price was 100%, 75.6% and 28.7% in the PC, RA-R and AR channels respectively. Transport costs constituted the major marketing cost item. It is suggested that chicken and egg marketing of rural chicken farmers can be improved through formation of marketing groups and training of farmers in enterprise development.

34.	2006	Turkana avian flu surveillance using participatory disease Search (PDS) report. October 2006. Ministry of Livestock and Fisheries Development. Ojigo, 2006.	Surveillance	This study involved targeted surveillance of avian influenza in a high risk area after the outbreak of the disease in Juba, Southern Sudan. The study shows the efforts of the disease in ensuring early detection, prevention and control of the disease by increasing the vigilance through improved vigilance during outbreaks in neighbouring countries.
35.	2001	1999 Population and Housing Census. Volume I, 415pp. Republic of Kenya (RoK) (2001).	General	This gives information on the Kenyan population by age, sex up to the sub-locational level that is the smallest administrative unit. The information is important as poultry an important source of animal protein especially to the rural poor.
36.	2004	Strategy for revitalizing agriculture (2003-2008). Government Printer, Nairobi, 74pp. Republic of Kenya (RoK) (2004).	General	It provides the policy framework for the implementation of the Economic Recovery Strategy for Wealth and employment Creation in the Agricultural sector. It provides key (sex) policy measures to make agriculture a commercially-oriented sector and internationally competitive.
37.	2006	Medium Term Expenditure Framework 2006/2007-2008/2009. Report for the Agriculture and Rural Development (ARD) Sector. Final Draft, February 2006, 82pp. Republic of Kenya (RoK) (2006).	General	The Medium term strategy (2008-2012) provides a policy framework for supporting the implementation of the Vision 2030 for the period 2008-2012. It provides an overview of the flagship projects to been prioritised as well as addressing issues related to post-election violence.
38.	2007	Kenya Integrated Household Budget Survey (KIHBS) 2005/06. Volume 1. Basic Report, 329pp. Republic of Kenya (RoK) (2007).	General	The Survey provides a synthesis report of the initial results from the integrated household budget survey using CBS [KNBS] clusters on a national basis.
39.	2007	Economic Review of Agriculture. Ministry of Agriculture. The Central Planning and Monitoring Unit, 51pp. Republic of Kenya (RoK) 2007 &2008.	General	This report is an overview of the contribution of agriculture to national economic growth. It provides data on acreage and production of major crops in different parts of the country.

40.	2006	Avian Flu Threat: Socio-economic assessment of the impacts on poultry-related livelihoods in selected districts in Kenya. A draft report of the Pan African Programme for the Control of Epizootics diseases (PACE). Kimani T., Obwayo, N., Muthui, L and Wahome, W, 2006.	Evaluation	This was a socio-economic impact assessment study on the avian influenza scare in Kenya (200-2006). The study indicated that the scare caused huge economic and social losses. The effect of the scare was not only in the poultry sector but also others. The financial losses were estimated at Ksh. 2.5 billion. This study shows why it is important to have proper communication during avian influenza scare and also the level of impact during such scenarios. The impact of avian influenza incursion will even have a bigger impact.
41.	2006	Small-scale poultry producers: falling foul of avian flu? *Agriculturalist Online*. http://www.wrenmedia.co.uk – last accessed 12-04-2008.Sones, K. (2006).	General	The study emphasises on the role of poultry for small scale producers and the need to diversify using poultry as an avenue for poverty alleviation. Thus avian influenza will lead to deterioration of livelihoods as it would affect poor farmers livelihoods and have a great bearing on the food security and health of the producers
42.	2008	United Nations Development Program (UNDP) Human Development Report 2007/2008 – Kenya. http://hdrstats.undp.org/countries/country_fact_sheets/cty_fs_KEN.html - last accessed 28 March 2008.	General	The information gives information on the contribution of various sectors on food security, thus details the role of poultry in development.

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ANNEX 3. Organogram for the Ministry of Livestock Development and collaborating Institutions