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EARLY DETECTION, PREVENTION AND CONTROL OF AVAIN INFLUENZA IN KENYA: OSRO-KEN-601-UK

A REVIEW OF POULTRY INDUSTRY AND BIOSECURITY STATUS IN KENYA

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EXECUTIVE SUMMARY

The FAO avian Influenza project conducted a rapid assessment of biosecurity status using a few selected districts in Kenya. The importance of the study was based on the fact that biosecurity is the cheapest and one of the most effective means of controlling entry or escape of a disease along the poultry value chain. The aim of this study was to assess the current biosecurity status, risky practices that may facilitate entry or spread of HPAI into the country and the major constraints in implementation of biosecurity practices and policies at farm/market level. Opportunities for improvement of biosecurity were identified which will be used to develop practical biosecurity guidelines appropriate to specific production, marketing and processing scenario for safe poultry production, marketing and processing. During the study awareness creation was also done through distribution of materials on early detection, prevention and control of Avian Influenza. The study was carried out in four districts (Makueni, Kilifi, Busia, Bomet) and the periurban areas around Nairobi (Ngong, Ruiru, Uthiru, Wangige) representing all the different production and marketing systems from the high risk areas in the country. Study methodology involved household interview using structured questionnaires as well as focused group discussions of the key informants. The respondents included farmers, different traders at the markets and slaughterhouse operators. In addition to farm, markets, slaughterhouses, at least four hatcheries were also visited. A total of 410 households and 130 traders were interviewed. The study revealed that the four poultry production sectors are well represented in the country, but variations in terms of implementation of biosecurity practices conspicuously exist within each sector (except Sector 1 which is represented by one company).Biosecurity levels were found to be weakening as one goes down the sectors with sector 4 being completely insecure and very important in disease spread due to movement of birds both across and within regions for either trade or social purposes. In the event of disease outbreak in sector 4 restriction of bird movement should be well enforced in order to limit disease spread. Sector 3 is very vulnerable to disease incursion because of its dependency on sector 1 and 2 for inputs as well as the economic realities of the small holder mixed farming systems in which most of them are found. The following practices were identified as representing high biosecurity risk:

Sector 1 and 2: Litter disposal at the end of the cycle

Sector 3:

- Home slaughter of broilers, hence sale of un - inspected meat
- Within farm use or sale of raw poultry litter as fertilizer or dairy cattle feed
- Poor carcass and slaughter wastes disposal
- Some farms keep free ranging birds of different species alongside confined birds
- Minimal use of protective clothing by poultry attendants
- Feeding of raw offal to pigs and dogs

Sector 4:

- Poultry sheltered in the same house with people
- Poor vaccination of HPAI differentials such as NCD (in terms of coverage and consistency)
- Transportation of live birds without equipment and human protection
- Multi species and multi age rearing with free interaction between domestic and wild birds
- People slaughtering or selling sick birds

Lacks of awareness among different players, social, cultural, economic and institutional factors were cited as major factors responsible for the current biosecurity status. Farmers' training, enhanced stakeholder involvement, increased public awareness development of recording and documentation systems to enhance bird traceability, institutional capacity building and policy reviews are important measures that can greatly improve biosecurity in the poultry industry as well as make the sector more profitable.

1. OVERVIEW OF POULTRY PRODUCTION IN KENYA

1.1 Introduction

Poultry production in Kenya is undertaken in a multitude of ways, utilizing different sets of resources, in a wide spectrum of social cultural and economic conditions. Major poultry species kept include chicken, ducks, guinea fowls, turkeys, pigeons, quails, and ostrich of which chicken dominate the industry. Indigenous chicken are predominantly found in the rural areas where they play a key role in enhancing household food security. Commercial poultry keeping is practiced in the urban and peri-urban areas, utilizing specialized hybrids in which broilers outnumber layers. In the rural areas most of the local consumers prefer indigenous chicken and eggs; this has made it difficult for development of the commercial hybrids in such areas.

Poultry farming in Kenya is based on the multiple uses of animals other than the specialized single product animals. For instance only 23 and 10% of farmers interviewed in this study said they keep poultry for only income and food respectively. The main reason for keeping poultry across all the production systems is to provide food and income (73%). Multiple roles of animals are however variable in different social economic settings e.g. in Busia other than food and income, the role of birds in providing food, income, and social reasons was highly recognized by about 32 % of the respondents while the 23% of peri-urban farmers emphasized on the provision of manure in addition to food and income. Poultry producers are either individual or producer groups. Group role include sharing experiences, sourcing for product markets; price negotiations and financial support to members through table banking schemes which make them good entry point for interventions such as disease control

It is envisaged by players in the industry that through value addition and promotion of utilization of poultry and poultry products, the industry has a potential for increased growth. For instance, while feathers have many uses in other countries such as making ornaments, pillows and duvets, in Kenya this has not been well utilized as a way of increasing overall productivity of the poultry enterprise. During this study it is in only one slaughterhouse (Mombasa) where some feathers from indigenous chicken were being dried and packaged for export market (albeit at a very small scale). We also found some traders at Kariokor market, Nairobi preparing the skin of the chicken neck (indigenous) so that they can be used to make fishing hooks. The hooks are imported from Japan and Norway and after fixing the skin they are exported to US, Canada and Britain. Though these activities are at a very small scale, it reflects how much can be exploited within the poultry industry.

1.2 Urban and Peri-urban poultry farming

Urban and peri urban agriculture is one of the unique but very significant components of Kenyan intensive farming system. The key determinant for choice of enterprises under urban and Peri-urban agriculture is the land size. Livestock enterprises such as dairy and poultry are the most important enterprises because of high returns per unit of inputs as stimulated by increased human populations in the urban areas who continue to raise the demand for animal products. The relative importance of one enterprise over the other is highly influenced by size of land holdings as well as the economic dynamics in specific urban areas. Poultry farming, because of its dependence on external outputs is a very important economic activity among small holder farmers especially where land to produce fodder for dairy is a constraint. Generally in Nairobi, Thika, Kiambu, Ngong, dairy is the most important followed by poultry with Nairobi as the major focal point for marketing both raw and processed milk. Farmers in these areas find dairy to be less risky in terms of costs of inputs and sensitivity to input quality; e.g. farmers can formulate their own feed rations without compromising performance. Poultry is perceived to be very sensitive to quality of inputs such as vaccines, feeds, genetic material and generally is labour and capital intensive. Milk marketing and the income from the dairy enterprise is more reliable than poultry due to the higher consumption of milk than poultry products. In order to spread risks and to complement each other, about 80% of the farmers keep both poultry and dairy. At the coastal region, the situation is different, poultry is more important than dairy because of the thriving tourism sector. Besides, the large number of Muslims along the coastal region is a major boost to poultry industry because it's the only alternative to beef. Poultry production at the coast therefore follows the tourist patterns.

Poultry species reared include chicken, ducks, turkeys and geese. Small scale farms keep an average of 100-1500 birds while large scale farms keep an average of 1,500-5,000 birds. On the extreme end, farms with over 5000 birds are also common especially in Thika and the coastal region. Ducks are very common depending on the living systems with about 3-4 ducks per household. In the high income areas ducks, turkeys and geese are generally kept for prestige. 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 along with other pet birds.

Another very unique feature of urban and peri - urban poultry farming is poultry keeping in the slums especially in big towns like Nairobi, Kisumu and Mombasa. For the slum dwellers keeping birds is an important source of supplementary income and food; one mature duck can be sold at Ksh 3,000. Birds are usually on free range and at night are sheltered in one single room where every household member lives. Some people try to improve the situation by putting the birds to sleep in some containers such as baskets, and basins. Due to the vulnerability of chicken to theft, ducks form the biggest proportion of birds kept in the slums. Other conditions in the slums that favour ducks to chicken are their ability to wade and feed in the sewage and the open drainages that are common in the slum areas. They are also known to walk far away to

look for food and lead each other 'home' in a line so that none is lost. Getting information about livestock keeping in the slums is very difficult because many farmers do not own up the roaming animals for fear of the local authorities.

1.3 Institutions providing services to poultry industry:

The government through the Ministry of Livestock and Fisheries Development is the leading agency in providing extension and veterinary services in the country. The government also through donor funded projects has put a lot of effort to strengthen poultry industry by promoting commercialization and value addition of the indigenous poultry. For instance in Makueni district, Agricultural Business Development (ABD) project in the Ministry of Agriculture is focusing on streamlining poultry marketing systems by creating and strengthening linkages between producers, processors, and other players in the marketing chain. To achieve this, improved information systems and capacity building of service providers for enhanced farmer empowerment is one of the major approaches by the project. The project has stimulated growth of poultry industry in the district as reflected by increase in the number of birds per household from 10 to about 20.Other indicators include the coming up of entrepreneurs who have started slaughterhouses for improved poultry marketing. The Kenya Agricultural Productivity Programme (KAPP) and the National Agriculture and Livestock Extension Programme (NALEP) are also supporting poultry farmers through promotion of poultry based Common Interest Groups (CIG) which forms an entry point for interventions aimed at improving poultry production and marketing.
Other organizations include World Vision, Micro finance institutions, Catholic Church, Anglican Church, Agro chemical companies and the farmers. The role of Agro vets in providing services to poultry farmers was emphasized during discussions in all the districts visited. These services mainly included supply of inputs and limited extension services. Due to the potential impact of Agro vets in animal health service delivery system; there is need for the government to ensure that such outlets are manned by people with the necessary technical qualifications to ensure that farmers get quality services.

1.4 Constraints facing poultry industry in Kenya

1. Chicken meat is still very expensive for many people to access (both for indigenous and exotics); in many households, even those rearing chicken; it is eaten once in a while or on special occasions. This problem is exacerbated by the fact that in many retail outlets, chicken is sold as a single piece unlike other protein sources where consumers can buy units they can afford e.g. beef, pork, mutton units can be as small as 250g. Consumers who cannot afford the whole chicken (an average of Ksh 300) will resort to alternative meat.
2. Poor quality feeds: due to poor feed quality most farmers have to give more feed to achieve the right body weights and laying percentage. Farmers

sometimes have to incur added costs such as adding more fish meal to improve quality of already overpriced poor quality feeds. This is blamed on high cost of feed ingredients due to competition for the same with human food. Even for farmers who choose to manufacture their own feeds, the high cost of ingredients makes it uneconomical unless they compromise on quality. For instance, in one group discussion, farmers complained that when there was a shortage of *Omena* fish in the country traders took advantage of this and supplied adulterated materials e.g. one farmer reported that when there was a shortage of *Omena* some traders had sold to him *Omena* mixed with sand

3. Disorganized marketing systems; prices are very low during times of overproduction because small scale farmers lack storage facilities (Prices can go down from Ksh 300 to 180 per piece); in such desperate times, middlemen take advantage of farmers and buy at a throw away price and most of them do not pay promptly, some even run away with the money; most farmers pull out because they do not have capital to start another cycle. Markets normally remain low for a longer period and high for very short period; there is need to streamline poultry marketing. Other options include investment in cold storage facilities. Some hatcheries pose serious competition because they also rear broilers and therefore compete with the same farmers they had supplied the DOC. Another marketing problem is where people jump in and out of the business (poultry farming) because they think it is the easiest business to do when someone has some little capital. They end up flooding the market and then pull out due to discouragement and since they have little capital, they do not come back.
4. Lack of adequate capital to invest in poultry production especially among the small scale operators: Given the small scale nature of Kenyan production systems, many farmers lack the capacity to invest so as to meet the recommended standards. For instance in sector 3 which is predominantly found in urban and Peri-urban areas poultry theft is very common because the simple houses built for chicken predisposes them to theft. To control this, some farmers choose to keep birds in their own houses or construct poultry houses very closely to their own houses. In free ranging birds under mixed farming systems farmers have to confine their birds to protect the flowering crops. Due to lack of proper housing and feeds, bird performances (egg production and growth rates) reduce. Lack of accessible and affordable credit facilities is the main reason blamed for low capitalization.
5. Generally there is limited technical know - how among farmers: For instance due to lack of proper vaccine handling skills, many farmers reported cases of infections among birds that have already been vaccinated. Inadequate husbandry skills are also reflected by the poorly implemented management practices such as in housing, feeding and breeding.
6. High bird mortalities due to disease and predation: Outbreak of diseases such as NCD is very common in the free range production systems. When they occur huge losses are incurred; farmers reported that whenever the disease strikes, the

whole flock is whipped out and they have to start all over. The disease spreads rapidly due free interaction of birds within villages. Some diseases such as NCD are seasonal while others such as Fowl Pox which is more fatal in chicks occur through out the year. In the upper zones, the main parasites are the fleas and lice while soft ticks are important in the lower zones. Predation is facilitated by poor housing. The major predators include the hawks, mongooses, snake, and skunks. Losses to predators can sometimes reach 100% especially in chicks

2.0 DESCRIPTION OF POULTRY PRODUCTION SYSTEMS IN KENYA

2.1 Introduction

Generally poultry production in Kenya is classified into two distinct production systems based on scale, functions, breeds, husbandry and productivity; these systems are conventionally referred to as the commercial intensive systems and the free range or village poultry production systems. The commercial intensive systems are generally characterized by exclusive confinement of specialized high producing hybrids which are fully fed on concentrate feeds. The system is highly commercialized; capital and labour intensive with presence of disease control regimes in varying levels. On the other hand, the free range or the village production system is primarily based on indigenous chicken under scavenging feeding systems and traditional management. The free range system has existed in Kenyan villages from time immemorial as an integral component of the whole farming system. The economic strength of indigenous chicken lies in the low cost of production when compared to the value of the outputs. At the interface between the commercial and the free range system is the semi intensive also referred to as backyard system. This is an improved free range system which is common both in the rural, urban and Peri urban areas. This is a system in which birds are partly confined and partly left to scavenge .The system mainly, utilizes Indigenous breeds and their crosses with exotic breeds.

In specific relationship with Avian Influenza, the Food and Agriculture Organization (FAO) of the United Nations has grouped all the systems of poultry production into four operational sectors, viz:

1. Sector 1: Large scale integrated commercial system: Raising grandparent stock and parental stock with high management and biosecurity standards;
2. Sector 2: Medium scale intensive commercial system raising commercial broilers, layers or parent stock with moderate to high management and biosecurity levels
3. Sector 3: Small scale commercial production systems that raise commercial poultry only usually under intensive husbandry; low management and biosecurity levels
4. Sector 4: Small scale village or backyard system: practice free unselected flocks of multi age and mixed species under low management and biosecurity levels

Under the above FAO classification system, Kenya has all the four sectors of production in which sectors 1-3 covers the intensive commercial production systems

while sector 4 covers the free range or village chicken production system. The major features of different sectors are presented in Table 2.1

Table 2.1: Major features of the four production systems in Kenya

Major features	Sector 1	Sector 2	Sector 3	Sector 4
Integration scale	High:99% vertically integrated	X/√	X	X
(1) Grandparent stock	√	X	X	X
(2) Parent stock	√	√	X	X
(3) Hatchery	√	√	X	X
(4) Intensive rearing	√	√	√	X
(5) Mixed species	X	X	X/√	√
Own feed mill:	From a sister company (Unga)	X/√	Farmer Groups	Home made rations
Own Vet and animal health services	√	X/√	X	X
Mechanization	Full	Medium	X	X
Biosecurity Scale				
Perimeter fence	√	√	Minimal/X	X
Standard housing	√	√	Minimal/X	X
Movement restriction	√	√	Minimal/X	X
Staff hygiene, showering	√	Minimal/X	X	X
Facility & Equipment	√	√	Minimal/X	X
Hygiene	√	√	X/√	X
All In All Out				
Products				
Parent stock DOC	√	X	X	X
Commercial DOC	√	√	X	X
Table eggs per farm	X	√ (individual)	√	√
Meat	√	√	√	X
Live birds	X	X	X	√
Further processing	√	X	X	X
Economic roles:				
Labour generating scale	√√√	√√	√	X
Import and Export	√√√	√	√	X
Rural / culture Impact	√	√	√	√√√

2.2 Poultry sector 1 in Kenya

The industrial integrated system in Kenya is represented by one holding, the Kenchic Company Ltd. Being in the upstream of the production chain and by virtue of possessing the Grand Parent (GPS) and Parent Stock (PS) for broilers, Kenchic serves as a foundation for a big proportion of the commercial broiler production in the country. Fig 1 shows the interaction between different poultry sectors

2.2.1. Structure

Kenchic is 99% vertically integrated with 80% of its activities being on broiler production, processing and marketing. The company is a franchise holder for Aviagen (the breeders of Abboecus breed) in East and Central Africa. Day Old Chicks (DOC) for the GPS are imported from America and raised in the six breeder farms at Kajiado, about 30 km from Nairobi. Other breeds reared are the Isa and Bovver for Layers. The PS produced from the breeder farms are sold to other hatcheries both locally and to other countries in the region.

The company produces DOC (layers and broilers) for commercial farmers. 60 % of the broiler DOC produced at the hatchery is sold to independent farmers while 40% are raised by Kenchic in the company's farm at Athi River and through the contract farmer system. The contract farms are fully managed by Kenchic. The minimum number of birds a farmer can be contracted to keep is 3,000 but the company is in the process of moving to 12,000 birds. Currently the farmer with the highest number is keeping 21,000 birds. Kenchic provides a once a week visit by the technical team to the farms including providing veterinary care. The farms must conform to the standards set by the company in as far as housing, biosecurity, and feeding is concerned. Contact farms are located in Machakos, Karen, Ngong, Kiambu, Thika, and Murang'a. The Company owns a modern export processing plant in Limuru (Tigoni) for slaughtering, packaging and marketing of broilers from the farms. The company has franchises for fast foods in major cities through which most of the products are marketed. Some products are also branded and sold to other retail outlets and butcheries.

2.2.2. Population and Hatchery production and capacity:

Table 2.2 present the population of different category of birds under Kenchic establishment. The hatchery has a capacity of about 400,000 DOC and is currently operating at a weekly production of about 250,000; 30, 000 and 6,000 DOC for broilers, layers and parent stock, respectively.

Table 2.2: Population at Kenchic Hatchery

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

2.2.3. Housing and husbandry practices:

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 houses have laying nests from which eggs are collected, sorted, graded and packaged awaiting delivery to the hatchery. Feeding and watering is through an automated system. Laying percentage for layers and broiler parental stock at peak production is 94% and 84-88% respectively. The hatchery has an established vaccination programme for disease prevention in the GPS, PS, and the commercial flocks. For DOC to be released to the farms the layer chicks are vaccinated at day old against Marek's and New Castle diseases. Routine disease searching is done by taking random samples from the farms and slaughterhouse and analyzed for presence of pathogens at the company's laboratory located at West lands.

2.2.4. Biosecurity Practices in Sector 1

The following are the main biosecurity practices observed at Kenchic

A. Control of entries:

1. Entry into the breeder farms, hatchery and slaughterhouse is completely restricted. There is tight security at the main gate, one has to fill a form showing his/her history (in terms of movement for the last one week) and heath status If visitors have to enter into the farms, the following conditions must be met:

    - That the visitor (including Kenchic staff) has not been in contact with poultry or 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 while entering the breeder farms and change into clean uniforms. The bathrooms are divided into dirty areas where the visitors clothes and shoes are left and clean area where clean clothes for changing after showering are placed
    - 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 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 clean staff uniform (they must shower again any time they go out of 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
   - Vehicle 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.

B. Isolation

- Ken chick breeder farms are located in Kajiado district along Nairobi - Kajiado road, in a remote place located away from dense human settlements.
- There are 4 breeder farms with a distance of about 12 km apart.
- 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 48 hours.
- To ensure that people living around the farms do not keep chicken, the company provides them with poultry products free of charge.

C. Sanitation:

- 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.
- 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 *E. 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 under go a series of disinfection and fumigation before being put in the setting machines.
- The company sources feeds pelleted 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. Pit for one cycle cannot be used during another cycle.
- Hand sanitation points are available in the poultry houses, hatchery and slaughterhouse

D. Control of rodents, wild birds and other animals

- 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 off 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 to keep off animals

E. Slaughterhouse:

In additions to the biosecurity practices listed above the following apply to the slaughter house:

- 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 NEMA recommendations and deposited to a river
- All the solid waste is disposed by a private company hat has been contracted to do so.

2.2.5. Biosecurity Limitations in Sector 1

Basically, Ken chick has put in place the required polices and practices to prevent entry of pathogens into the farm, or slaughter point. The only limitation observed was on disposal of manure at the end of the cycle. It was reported that at the end of every cycle, litter from the poultry house is bagged and sold to farmers as fertilizers. This can lead to spread of diseases to other farms. It was also not established where and how the disposal of solid wastes from the slaughterhouse by the contracted private company is done. In some cases cull birds especially spent layers are sold at an open air market at Mulolongo so as to minimize entry of traders to the farms. Although these are believed to have come from clean areas it is more hygienic to have the company slaughter them.

2.2.5. The Potential role of Sector 1 in the spread of HPAI

Since the PS and GPS are all imported, this sector is of particular importance in as far as introduction and spread of avian influenza is concerned. For instance if infected birds are brought into the country, the entire national commercial flock is at a very high risk because sector 1 largely interacts with all the other sectors as the main source of DOC (including Sector 4 because of the newly developed free range breed, the Ken Bro which farmers are extensively using to upgrade the indigenous birds). The main strategy to mitigate against potential risks is therefore to ensure that the foundation flock is free from both the vertically and horizontally transmitted diseases. The scope and intensity of biosecurity in the farms is the main determinant of the disease prevention and control efficiency. At Kenchic these practices are quite satisfactory and so long as importations are restricted to disease free flocks, the risks are minimal.

(b) Biosecurity practices at Kim's Poultry Farm:

A. Isolation:

- The farm rearing PS is located in Kabarak farm, away from dense human settlements (the farm is surrounded by schools, hence no poultry activity). In the next few months the farm will be relocated to Solai for enhanced isolation. The hatchery and the slaughter house are located at different location from the PS
- All poultry houses are made of solid walls with bird proof ventilations
- Each house has its own workers and equipment
- All in All out system of production (at the poultry unit level)

B. Control of entry

- Visitors are not allowed beyond the office; if one must go beyond the office, they must shower and wear gum boots and dust coats; There are sign boards showing that the farm is a quarantine area hence restricted entry
- The history of the visitor must be taken so that if he had any contact with poultry before, he is not allowed in.
- Workers are not allowed to keep chicken at home
- Workers have to shower before entering the poultry premises and wear clean overalls and gum boots.
- Workers are restricted to remain in their respective poultry houses
- Each house has its own set of equipment
- Employees trainings: A meeting is held once a month to discuss important issues, including biosecurity; new workers are first trained on biosecurity in the farm and thereafter attached to a crop leader until they fully understand and are able to implement the practices

C. Sanitation

- At the end of the cycle, there is a rigorous cleaning (including pressure washing), disinfection (both inside and outside of the house) and fumigation process for the houses and equipment
- One month Sanitary gap
- Dead carcasses and egg shells are buried in pits, 10 feet deep.
- Foot and wheel bath at the entrance of the farms and hatchery
- Farm and visiting vehicles sprayed with disinfectants before entering the premises
- Disinfection of eggs before delivering to the hatchery

D Vermin control

- Glue (Attragat®) applied on heavy woods to hold rodents and other pests as they pass
- Manual killing of rodents

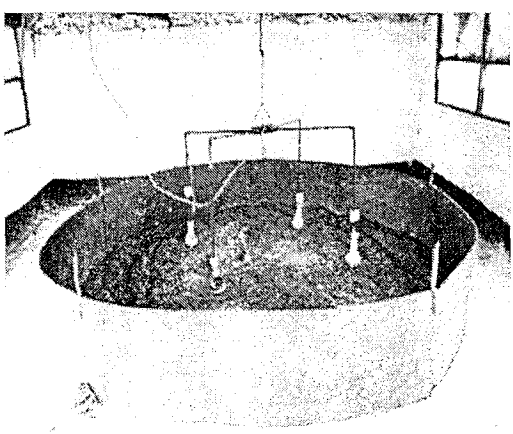
(c) Biosecurity Limitations at Kim's Poultry Farm

The only limitation observed was on disposal of manure at the end of the cycle. It was reported that at the end of every cycle, litter from the poultry house is bagged and sold to farmers as fertilizers. This can lead to spread of diseases from to other farms. Liquid waste is drained into the main Sewer system while the solid slaughter waste is disposed off by the municipal councils.

2.3.2. Individual Sector 2 Farms

(a) Description

Most of the sector 2 individual farms are found in Ngong, Thika, Nairobi (Karen), and at the coastal region, producing table eggs, broilers or both. These specifically target big hotels and supermarkets in Nairobi, Thika and Mombasa as their market outlets. The farms are non franchise producers who source their own capital and operate independently of sector 1 (Kenchic) save for supply of DOC. Average number of birds kept is 8, 000 - 10, 000 and 5,000 – 10,000 broilers and layers respectively with considerably high biosecurity levels and automation (Feeding and watering systems). Some individual farms in this sector are integrated with a hatchery to produce own chicks, a feed mill and a slaughter house. Before Avian Influenza scare of 2006 some of these farms were importing the genetic material from Mauritius and Israel among other countries. The slaughterhouses are wholly private and are regularly inspected by the public health and veterinary officials. Products from these farms are mainly DOC, table eggs and broilers. Product quality is not questionable because in an effort to meet the demands from the target markets, the farms ensure that inspection of facilities and birds (before and after slaughter) is done by the relevant authorities and certificate of inspection offered. Generally veterinary and animal husbandry services are outsourced from the government or private sector and have very strict disease control regimes. Other than, the broiler and layers farms there are other sector 2 farms which hatch and rear other species of poultry e.g. GEM (Chicken, Guinea, Ostrich, Ducks, Guinea fowl), Nightingale Farm (Turkey)



(a)

(b)

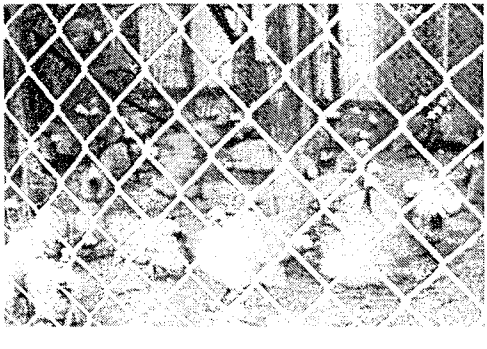
(c) (d)

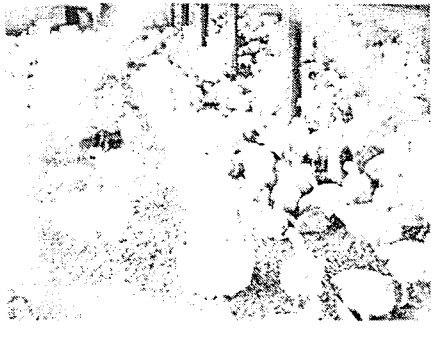
Modern equipment used in sector 2: (a) infra red brooder; (b) a defeathering machine; (c) Wheel bath with and a gate restricting entry of visitors into the farm and (d) containers for transporting poultry meat

(b) Biosecurity practices in sector 2 individual farms

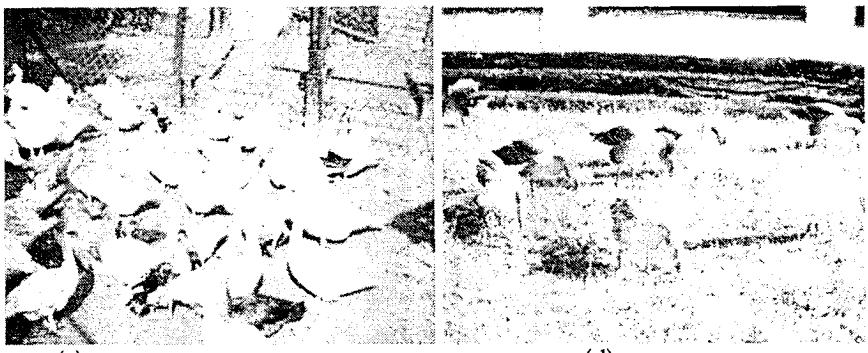
Among the farms visited the following practices were fully in place and operational

1. Disinfectant at the gate for vehicles and feet. each and every entrance and doors to the poultry houses has disinfection points
2. Restriction of entry into the farm (notices are put at the gate e.g. at Hedge and GEM farms
3. Workers are provided with gum boots and overalls for use in poultry houses, hatchery and slaughterhouse
4. Policy for visitors is to shower two times and wear the provided clothes and gumboots
5. Policy for workers: when workers come to work, they are expected to shower first and wear clothes for work and take their own clothes as they go back
6. All dead chicken are buried in pits within the farm
7. Septic tank available for liquid waste from the slaughterhouse. After slaughtering is complete, the houses are washed and disinfected which ultimately flows into the septic tank
8. Farms with different species (GEM's farm) have separate workers for specific species, slaughterhouses, breeding stock and hatchery
9. At hedge farm, feathers first are made to decompose and used in the farm as fertilizer





(a) (b)



(c) (d)

Different poultry species reared in sector 2: (a) guinea fowls; (b) Broilers; (c) ducks; and (d) free ranging geese

(c) **Biosecurity Limitations; in Sector 2 individual farms:**

Generally at the end of the cycle, raw manure is sold to other farms. Some farms however like hedge farms have manure pits in which composting is done before use as fertilizer. Selling of the offal and other wastes to pig farmers or individuals for cooking is a common practice in most of the farms

2.3.3. Hatcheries (Sector 2)

(a) **General Description)**

These only raise the PS to produce DOC for commercial farmers. The System has some degree of integration through incorporation of feed milling and by virtue of rising of PS from DOC, hatching and marketing. Product marketing which mainly targets independent sector 2 and 3 farmers is either through the sales offices located in major towns (Mombasa, Kisumu, Nakuru), or through agents distributed all over the country or as direct sales to farmers. A small (about 10 %) percentage of DOCS is exported to Uganda and Tanzania. 95 % of PS is mainly imported from Holland, Germany, Zimbabwe, France, and United Kingdom. Only the Abboecus breed is sourced locally from Kenchic. Importation of fertile eggs may be done whenever there is a high demand of DOC than what the farms can produce. Some hatcheries e.g. Ideal Chicks (Sigma), as a matter of risk management have different farms for the DOC (PS) up to laying, layers and hatcheries while others have the whole system in one large farm but maintaining a safe distance between units. Management and biosecurity standards range from moderate to high. By nature of their products, hatcheries are very vulnerable to marketing challenges. The demand for DOC is very uncertain because of the nature of sector 3 farmers (the main targets) who because of other economic reasons, keep on jumping in and out of the business. Huge losses are incurred because of maintaining the PS whose products have to be killed for lack of markets (cost of maintaining PS is higher than

maintaining commercial layers). Major factors considered by the hatcheries before importation of genetic material include:

1. Quality control in the country of origin in terms of freedom from all transmittable diseases
2. Full history of the vaccination programmes
3. Past import history

Table 2.3: Capacity and production from 2 hatcheries visited:

Hatchery	Capacity (Per week)	Current Production	Remarks
Ideal Chicks (sigma)	Broilers: 40, 000 Layers: 20,000	Broilers:20,000 Layers:6,000	Brings in 2-3 batches per year
Muguku Ngong	Broilers: 60, 000 Layers: 20,000	Broilers: 30, 000 Layers: 10, 000	
Muguku Kikuyu*	Twice as Much as Muguku Ngong	Twice as Much as Muguku Ngong	

* Information on Muguku Kikuyu was provided by Muguku Ngong because the two are sisters companies

(b)Biosecurity Practices in the hatcheries:

Generally the practices below are operational in most hatcheries. It is important to note that some do not strictly follow them, hence the need to provide information so as to have equal standards in all hatcheries.

- Visitors are not allowed beyond the office; if one must go beyond the office, they must shower and wear gum boots and dust coats; Visitors who has 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
- Workers upon reporting to the farms must shower and put on clean uniforms.
- Routine cleaning and disinfection of equipment
- Sanitary gaps 3 weeks – 6 months
- Separate workers and equipment for each units
- Rigorous cleaning, disinfection and fumigation of houses and equipment upon end of the cycle
- Employee training : New employees after initial induction are attached to a senior worker and supervisors until they are competent on all aspects
- Placement of baits outside poultry houses to control rodents
- Incinerators and burial pits are available to dispose of carcasses

(c) Biosecurity limitations in the hatcheries:

Just as in Secto1 and other Sector 2 farms, sale of raw manure at the end of the cycle is a common practice. In some hatcheries reject chicks are sold to traders who go to sell in the open air market at very low prices. In such cases, the companies do not accept any liability

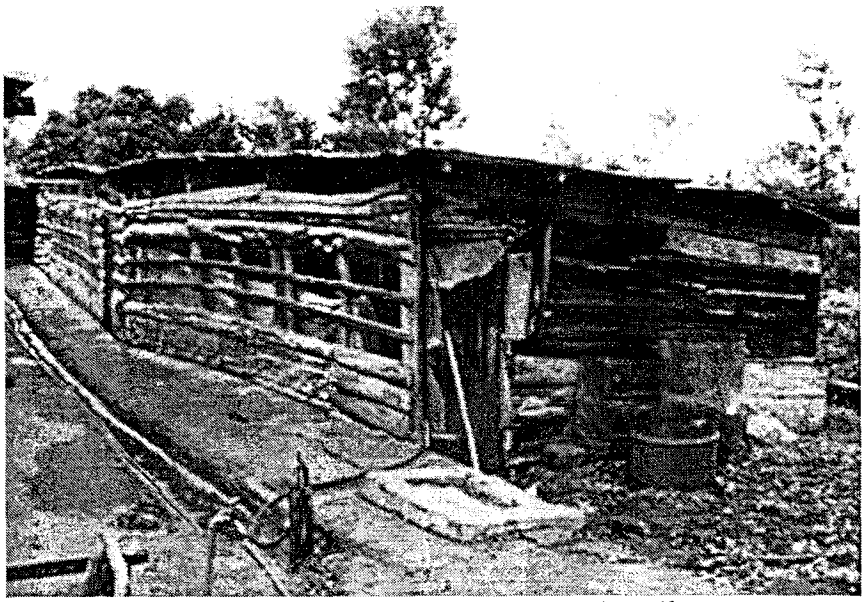
Table 2.4: List of a few Sectors 2 Farms and their products

Name of farm	product
Kim's Poultry farm - Nakuru	DOC, Table Broilers
Muguku Poultry Farm -Kikuyu	DOC
Muguku Poultry Farm -Ngong	DOC
Gem poultry Farm - Kilifi	Table Broilers, Table Ducks, Table Guinea Fowls, Feathers (G. Fowls); Quills
Kenya Bixa Poultry Farm – South Coast	DOC, broilers, table broilers
Hedge Farm - Kilifi	DOC, Table eggs, Table broilers
Lake side Hatcheries - Kisumu	DOC
Ideal chicks (sigma) - Nairobi	DOC
Nightingale Farm - Nakuru	Table Turkeys
Ken Brid - Naivasha	DOC
Maasai Ostrich Farm : Kitengela	Ostrich meat and other by products

2.4 Characteristics and biosecurity limitations in sector 3

Sector 3 is predominantly found in the urban and peri-urban areas around the towns and cities due to the ease of transportation of inputs and availability of products' market. This is a small scale system within small holder mixed farming systems whose average land size is 0.25-2 acres. Land use in these systems is very intensive as farmers aim at maximising outputs to meet the ever increasing market demands. The enterprises are therefore complementary and must all coexist for increased productivity of the system. For instance, to optimize the output from the poultry enterprise, the poultry litter is either sold or fed to dairy cattle or used to support crops in the same farm. In addition slaughter waste is either fed to pigs or sold. It is important to emphasize the value of poultry manure in this system and it is regarded as a scarce commodity for cattle feed; a 120 kg bag is sold at Ksh 200- 400. This is exacerbated by the middlemen buying small quantities of raw manure from different farms, bulking it and selling to other farms

In some farms due to small land sizes, poultry houses are normally built on top of dairy sheds and the birds get stressed due to noise. In an effort to optimize land use cases of poultry houses constructed at near the entrance are common. Due to economic reasons most of the houses are made of materials such as off cuts and earthen floors which are difficult to effectively clean and disinfect. This system stands a risk of incurring the disease as it largely depends on sector 1 and 2 for inputs such as genetic material and feeds. Such farms also buy a lot of manure from other farms to support crops and fodder.



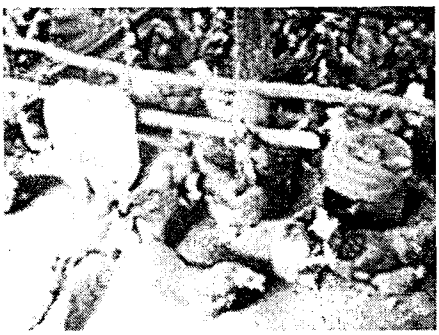
A sector 3 poultry farm constructed with off cuts, note there is a facility for disinfecting legs but it is empty

The largest proportion of sector 3 farmers specializes in either broilers or layers instead of mixing them. Poultry theft is common in the Peri - urban areas and some farmers opt to rear birds in one of the rooms within the family house. In this system free ranging chicken and ducks and geese are very common (an average of five ducks per household depending on the living system) and are mainly kept for security purposes as farmers find dogs to be expensive to buy (One is Ksh 10,000) along with the associated cost of feeding. Geese are considered to be alert and are capable of attacking and unlike dogs, they cannot bite. In addition, the geese and ducks are important source of household meat and income (one duck can be sold up to Ksh. 3000). Since it is also market driven the populations of ducks and geese is relatively low. It is important to note that in high income households, geese, turkeys and ducks are kept mainly for prestige. This situation in Urban and Peri urban areas, in sector 3 farms in the rural areas such as Maragwa, farmers strictly keep only commercial birds and cannot risk having free ranging birds around because of fear of diseases. In such areas, even the indigenous chickens are confined to protect crops.

The most common diseases in this system include New Castle Disease, Gumboro, Coccidiosis and Fowl pox. Ecto-parasites such as fleas are very common in this system because farmers tend to avoid the control measures including sanitary gaps so as to reduce costs. One farmer confessed that he had to sell a flock of 400 birds because of infestation by ecto -parasites. Farmers have been able to manage Gumboro and NCD through vaccination. Problems associated with vaccination include: Vaccine Package in large doses which do not commensurate with the small flock sizes e.g. Gumboro

vaccine, sometimes Gumboro vaccine is not available; Gumboro Vaccines are not always effective; some agro vets sell expired or poorly stored vaccines

Farmers in this system are very sensitive to increased cost of production .This is because their profit margins are very small given the role of middlemen in marketing. Implementation of biosecurity practices depends on the cost involved. Feeding and watering equipment used in the houses range from standard type to improvised containers made from tins and jerry cans. Due to poorly adjusted and substandard equipment, spillage of water and feeds is common. Feed spillage leads to loss of feed (Uneconomical) while water spillage facilitates multiplication of pathogens. In many instances, the equipment is not adequate.



Some of the improvised feeders and drinkers used in sector 3

Only 21 % of the farms visited had functional foot baths; in 69 % of the farms, foot baths were not present at all while 10% had the facility but it is not functional. Most framers attribute this to the high cost of disinfectants such as Omnicide®. In an effort to reduce the costs while maintaining some form of disinfection at the entrance, some farmers pour Magadi soda on a damp piece of cloth. Use of protective clothing is very minimal and while you may find workers wearing dust coats, these are of no sanitary significance save preventing their clothes from dust. It is therefore common to find a worker leaving the poultry house and going to the shop to collect feeds and come into the poultry house to feed the birds.

Over 80 % of sector 3 farmers keep broilers due to the short production cycles. Marketing of broilers is very challenging because of high dependency on the middlemen. The major market outlets include hotels, butcheries (in towns and estates); Market based traders such as City market in Nairobi and individual consumers. There are no slaughterhouses available to serve small scale broiler farmers (even where they are available like Nairobi and Mombasa, the facilities are too small to handle a large number of birds). This, together with the fact that the target markets (due to lack of awareness), do not demand certificate of inspection before buying meat, has resulted to having all birds slaughtered at home. Birds are slaughtered in batches according to the market demands. Most farms do not have designated slaughter facility hence slaughtering is done overnight somewhere in the compound, sometimes in close

proximity to the poultry premises. Basically no inspection of birds or slaughter places before and after slaughter.

Washing hands during slaughter is assumed to be done during hot water defeathering while washing after slaughter is merely done to remove blood from the hands. In most farms blood from slaughter point drains into the shamba as dogs lick most of it. This poses direct risk of disease transmission to human during handling as well as environmental contamination. Under home slaughter system, generally product quality is therefore not guaranteed. Discussions with key informants revealed that when farmers notice signs of sickness in their flock, they chose to sell off to avoid the losses.

Small farm sizes do not allow for proper disposal of feathers and unaware of the potential environmental contamination, feathers are thrown in the shamba or along the road side. Slaughter wastes (material not packaged for clients such as intestines, legs, and heads) are either cooked and fed to pigs within the farms or sold to neighbours who keep pigs or to some women who go to cook and sell in the slums. Slaughter process for broilers involve hot water defeathering, evisceration and packaging of each dressed bird in polythene bags which are then packaged in plastic bags or gunny bags. Transportation is mainly in the public service vehicles for small scale producers or private transport for large scale farms.

2.5 Poultry sector 4 in Kenya

The sector 4 is characterized by a small number of indigenous birds (average of 10 per households) of different species and ages under scavenging feeding systems. The system has existed in the Kenyan farming systems as an integral component of the whole farming system. In the rural areas and particularly from the gender perspective, poultry is the most important enterprise for women because of the low capital and labour requirement and the ease of control and benefits. In this study, it was established that 80% of poultry is owned by women. The number and distribution of the indigenous birds is highly influenced by social, cultural, economic and the biophysical environment. For instance:

1. There is an inverse relationship between human population density and poultry population. Hence there is higher population of birds in the lower agricultural potential areas due to two main reasons:
    a. The hot climate in the lower zones favours faster growth of chicken than in higher zones. Cool climate in the higher zones is also associated with disease outbreaks especially the NCD
    b. Land use pattern and its linkage to poverty levels: As the agricultural potential diminishes in the lower zones, poverty levels increases as farmers do not have the capacity to increase productivity from these areas. Poultry therefore important for enhanced household food security and incomes

because of their low capital requirements. Further more; land which is a major limiting factor of production is not a constraint in these areas.

2. Social and cultural factors: e.g. In Western Kenya, domestic consumption of chicken is highly valued and more so very important for welcoming visitors and other social functions such as funerals. As such, the chicken population, though apparently was the highest among the districts covered (29 birds per household) is not let to not grow appreciably; In addition, this is the place you will find the biggest diversity of poultry species. In other areas such as Bomet, many farmers derive their livelihood through sale of chicken and eggs. They argue that two eggs may not be adequate for the whole family but if sold, they can be sufficient to meet the cost of producing maize meal from a posho mill; this has led to increased population of birds for household income (21). The population of indigenous chicken in the rural areas is least among the Maasai community because traditionally they were not poultry eaters; this practice is however changing with time.

3. In areas where there has been interventions in form of projects on poultry, the average number of birds per households is as high e.g. in this study Kilfi district, which has had a DANIDA funded project promoting Indigenous chicken had an average of 23 birds per household. 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 households, an effect that is expected to spill over in the whole district with time.

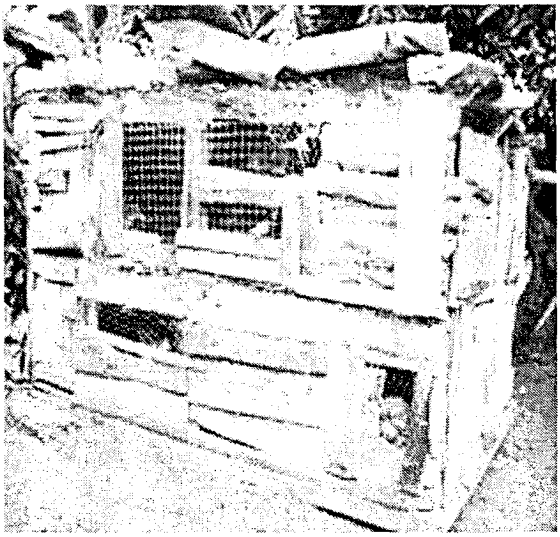
Management of birds in this sector is basically a traditional approach with improvements occurring along different social, cultural and economic perspectives. Housing of birds range from situations where birds sleep outside sometimes on trees to where there are permanent poultry houses in place as presented in Table 2.5 below

Table 2.5 Types of poultry shelter in sector 4 and the % number of farmer utilizing them.

District	Bomet	Busia	Kilifi	Makueni
No shelter, Birds sleep outside	1	4	8	8
Have hen house, made from locally available materials	65	25	22	36
Birds sheltered in the family house	31	69	59	39
Birds have a temporary night shelter	3	2	11	17

Lack of poultry house was mainly attributed to lack of finances, theft, predators and cultural reasons. Some farmers claimed that because they are afraid of losing their chicken to large predators such as honey bergers and thieves and lack of resources to construct strong poultry houses, they choose to share shelter with them in order to offer security.

The most abundant and cheap material for putting up poultry structures in many rural areas is soil, but its use is however limited by the presence of soft tick which is mainly found in the soil. It becomes very difficult to eliminate the soft tick once it establishes itself in the cracks in the walls of mud houses. Some innovative farmers in Makueni build elevated houses with some improvised stair case for birds to climb into the house (other farmers don't build stair case and have to assist the birds to get into these elevated houses). The idea behind the elevated houses is to make it difficult for large predators to access the chicken. In Kilifi, Some farmers use underground houses for their chicken: a pit is dug raised above the ground (about 1-2 ft) and then covered with soil. Cleaning and vermin control is however ineffective in such a house. Poor housing not only predisposes the poultry to predators but also makes implementation of vaccination programmes difficult because chicken are let out very early before vaccination is done.



Common houses for indigenous chicken made from locally available materials, mainly found in mixed farming systems where birds sometimes have to be confined so that they do not destroy crops.

In western Kenya and some parts of Bomet, keeping of entrusted birds is very common. This is mainly done for cultural purposes as well as for spreading the risk (mainly losses due to NCD).In Kilifi it is a social responsibility among the Giriama people to assist poor members of the community to acquire chicken. They do this by one person donating a hen to the poor person which he raises and after hatching the first batch, the owner collects the chicks and leaves the parent hen plus one pullet and the cycle continues until the person being supported has established a flock. In many communities, chicken are freely given out when one has an urgent need e.g. Among the Giriama people, if one has visitor comes and has nothing to cook; one can borrow from a neighbour and will not be expected to repay back. In the Luhya community, giving a relative a live chicken as a gift is a very important cultural practice, and it is

expected, one must take the gift as a sign of appreciation. These social cultural practices have a very important role in spreading diseases from one farm or region to another.

Free range system allows interaction between domestic and wild birds, between birds and other domestic animals as well as multi species and multi-age rearing. There is mixing of birds within neighbourhood as fencing between farms is uncommon. While this may be attributed to lack of money to establish fences, it is important to bear in mind that in the Kenyan rural systems, communities have over time harmoniously existed without structures such as fences to facilitate free entry of people and even animal across farms in the villages. The risk of birds mixing with domestic animals such as pigs is variable. For instance in Makueni, pigs are confined and it is rare to find roaming pigs while at the coast and some district like Bomet, rearing of pigs is very rare. In western province particularly in Busia district, pigs are still under scavenging system, hence incidences of tethered and roaming pigs is very common.

Implementation of disease control regimes is very poor in this sector. New Castle Disease is the most important disease of poultry. The disease is experienced in the cool months of the year, mainly in May- July; November- December. Since there are many other diseases that could be causing mortalities among birds, we asked farmers to tell us whether they have experienced poultry deaths due to disease and the number of birds they have lost at one given time. This is presented in table 2.6 which clearly shows that many households (60-72%) in sector 4 are affected whenever there is an outbreak. Losses are also high because on average, between 12 and 26 birds per households die which represent 60-80% mortalities per household.

Table 2.6 percentage of farmers who have experienced deaths due to diseases and the number of birds lost:

	Bomet	Busia	Kilfi	Makueni	Peri urban
Farmers who reported to have experienced deaths (%)	66	72	62	68	18
Mean number dead(STD)	12(39)	26(16)	12(5)	14(11)	64(118)

Vaccination being one of the effective disease control methods has not been well practiced in sector 4. Table 2.7presents the percentage of farmers vaccinating against major poultry diseases in sector 4 (which were represented by Bomet, Busia, Kilifi and Makueni districts) as compared to the intensive commercial system which are represented by peri-urban areas. Generally reasons for not vaccinating include: they can't afford (19-26%); lack of awareness on the need to vaccinate (41-51 %) and lack of qualified personnel to vaccinate (16-28%) among others. Farmers mainly vaccinate for themselves against various disease (61%) while 17% and 22 % depend on the private and government animal health service providers respectively. During group discussion it became clear that farmers are not keen to report diseases 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 all the districts visited at the divisional level; there is only one veterinary officer who is expected to undertake all the administrative, technical and regulatory roles. This agrees with the findings from the household survey in which the main reasons given for not involving qualified animal health service providers including the government staff were alluding to the same reason: some of the reasons given include: unavailability of the government staff (26%); they are expensive (19%); farmers who find it uneconomical to call a doctor for one or two sick birds (34%); are not aware of such services (21%)

Table 2.7: Farmers (%) vaccinating chicken against common poultry diseases

	Bomet	Busia	Kilfi	Makueni	Peri urban
NCD	55	42	34	13	81
F/TYPHOID	0	18	11	3	38
GUMBORO	2	4	29	4	80
F/POX	0	10	11	2	37

Another unique feature of sector 4 is multi species rearing. As was alluded earlier, Western Kenya is home to the biggest diversity of indigenous birds. It was narrated in Busia how quails are trapped and domesticated from the wild: During the harvest seasons some domesticated 'singer' birds (quails) are set in cages in the field to 'sing' and attract wild quails, which are trapped and sold as delicacies. Some of them however are left to be trained to sing for the next season. Pheasants are also trapped and domesticated from the wild; after which, they are let to fry out to the wild during the day and come back to roost in the evening. In many places where there are bushes, there is a lot of interaction between domesticated and wild with guinea fowls.

Free range system with mixed poultry species

Some farmers offer herbal treatments just before the NCD outbreak season. The common herb used is the Aloe Vera though other farmers combine it with Neem, *sonchus spp* pepper, croton leaves, red *amaranthus spp* and Guava leaves. A farmer reported such a mixture is able to protect her flock against NCD. During seasons of

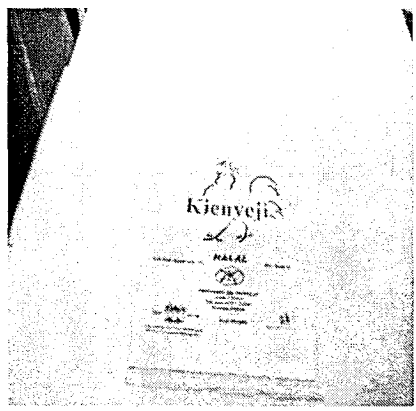
disease outbreaks the following practices were identified as risky practices which can facilitate spread of diseases

- A lot of 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 spread of diseases through the markets. Sick birds are sold cheaply and some hotels go for them because of the profit margins
- There is a belief that poultry diseases cannot affect man and therefore when one finds a bird is sick it is slaughtered before it dies so that it is not 'lost'.
- In some areas especially western Kenya, even birds that die are smoked and cooked. In Busia for example, when chicken dies, the carcasses are smoked and preserved for one week. The meat is mixed with ashes and grass from swamp, banana leaves or bean husks and cooked in an earthen pot
- Where such carcasses are not consumed by people, the common practice is to feed them to dogs in raw form

2.4.1 Marketing, slaughter and processing of indigenous chicken

Live birds and eggs are the main products from sector 4. Indigenous chicken and eggs are consumed in the whole consumer spectrum but with varying degree. In the past the highest consumption has been in the rural areas and towns dominated by local people. This trend is now changing as consumers develop a preference for indigenous birds reared under free range conditions. As a result the indigenous birds are highly priced in the live bird markets as well as at the retail outlets for the dressed birds. For instance, a 4-5 kg indigenous chicken in Nairobi can cost as much as Ksh 300-450 (4-5kg) while eggs from indigenous chicken are brought to Nairobi from as far as Kericho and Bomet in PSV where they fetch a price of about 250- 270 per tray. Due to the large number of middlemen involved, farmers do not enjoy this benefit. This explains why farmers producing indigenous chicken have not commercialized the enterprise. If farmers were able to enjoy the benefits of attractive prices of indigenous chicken, implementation of improved management prices such as vaccination and institution of biosecurity practices would not be difficult.

(a)



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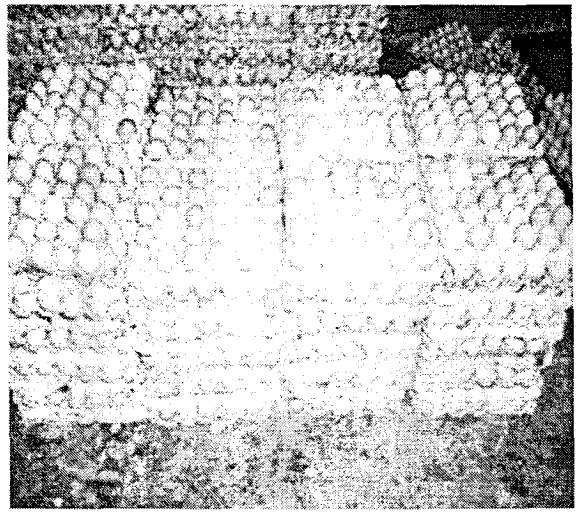


(d)

Poultry products ready for markets: (a) Inspected meat with an official Government stamp; (b) Branded packaging for indigenous chicken from sector 4; (c) broiler and indigenous chicken at the city market stalls and (d) eggs assembling point

Marketing is hierarchical involving bulking of birds from farmers by village based collectors through a series of middlemen up to traders in distant market who act as distributors to consumers, retailers, and institutions. The structure of sector 4 marketing chain is presented in fig. 2. Live birds markets are either formal or informal. Informal markets which operate with small number of birds targeting direct consumers are mainly found in urban, peri-urban areas and on the road sides. Formal markets on the other hand involve a large number of birds being traded and are recognized by the respective city, municipal and county councils. There are specific days for these markets which coincide with the conventional market days for all other commodities.

Use of slaughterhouses in marketing of indigenous chicken is a new approach that has been necessitated by the emerging poultry diseases and the need to value add poultry products. In some areas, especially those with Muslim consumers, use of slaughterhouse is gaining more relevance by providing an opportunity for buying chicken that has been slaughtered according to the Islamic requirement of cutting the neck by a Muslim *(Halal)*

There few poultry slaughterhouses in the country which are distributed as follows:

1. Thika -Thika town
2. Kariokor -Nairobi
3. Majengo -Mombasa
4. MacKinnon -Mombasa
5. Makueni styles –Wote, Makueni District
6. Sultan Hamud - Makueni district
7. Nakuru - Nakuru Town

As the strategy picks up, it is clear that slaughterhouses are under utilized as revealed by the average slaughter figures below:

Kariokor -100-150
Majengo - approximately 60-110
MacKinnon - approximately 180-350 per day
Makueni styles –approximately 100 birds per day
Sultan Hamud - approximately 30 birds per week
Thika - Data not available
Nakuru -Data not available

Operations in each slaughterhouse depend on the marketing systems in place. Generally slaughter process in all the slaughterhouses for the indigenous chicken involve inspection, dry defeathering, evisceration, inspection and packaging. Dry defeathering (manually) is the preferred method of defeathering as it minimizes contamination of the carcasses. Dry defeathering also helps maintain the characteristic yellow skin colour for the indigenous chicken which would otherwise be destroyed in hot water. Major outlets for products from the slaughterhouses include butcheries, hotels, individuals and markets e.g. city market in Nairobi. There are two models of operating slaughterhouses observed: (a) Slaughterhouses owned by the respective city or municipal councils (Public slaughterhouses). (b) Privately owned slaughterhouses

(a) Public slaughterhouses: these are located in cities and towns and are usually attached to terminal markets which receive live birds from up country. These have some element of integration in which market based traders buy live birds from distant traders and sell within the market to other traders within the city. The slaughterhouses attached to the terminal markets are useful for traders at the terminal markets which they utilize to offer value added services such as slaughtering in order to meet the clients' needs. 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. The traders and other people who need slaughter services pay to the council a certain fee (about Ksh 3) per bird. There are slaughter experts based at the slaughterhouses who are paid for every bird they slaughter (about Ksh 5).It is the buyers who determines whether carcasses should be washed or not, but generally hotels prefer washed carcasses while butcheries prefer not to have them washed to prolong their shelf life. The slaughterhouses have a government officer from the Department of Veterinary Services who is permanently attached there to inspect all the birds before and after slaughter. Upon inspection the trader is issued with a certificate of transport which is a valid government document for accountability, traceability and quality. The total slaughter costs of one chicken in the public slaughterhouse is Ksh 10 which include government revenue of Ksh 2, Slaughterhouse (council) chargers of Ksh 3 and fee for the people to slaughter, Ksh 5. Markets and slaughterhouses in this category include Thika poultry slaughterhouse,

MacKinnon Market in Mombasa, Majengo Slaughter houses and Kariokor markets in Nairobi.

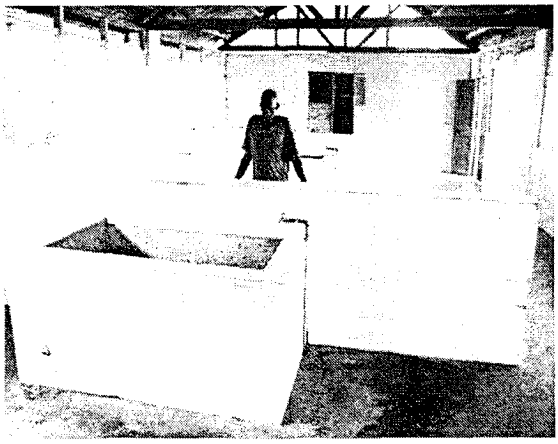
(b) Privately owned slaughterhouses: This category is represented by the Makueni styles and the Sultan Hamud slaughterhouse, both in Makueni district. Unlike ones owned by the councils, this category is a private venture by an entrepreneur who buys live birds from farmers and traders, slaughters, packages and markets their branded products. Services such as cleaning and sanitation, waste disposal and general maintenance are therefore a sole responsibility of the business owner. Other than being one compartment, these slaughterhouses have their different compartments for weighing; collection room for physical examination; waiting room and slaughter chamber .Sultan Hamud slaughterhouse has cold storage facilities. As soon as live birds are delivered to the slaughterhouse, they are weighed to facilitate payments to the suppliers. The delivered chicken are then kept in a collection room or some cages where physical examination is done .When a client asks for chicken, is it is selected from the cages or collection room, weighed and slaughtered.

In the slaughter chamber there are some metal funnels for restraining birds during slaughter and to facilitate bleeding and collection of blood. Officers from the department of veterinary services do inspect the birds before and after slaughter and offer a certificate of inspection.

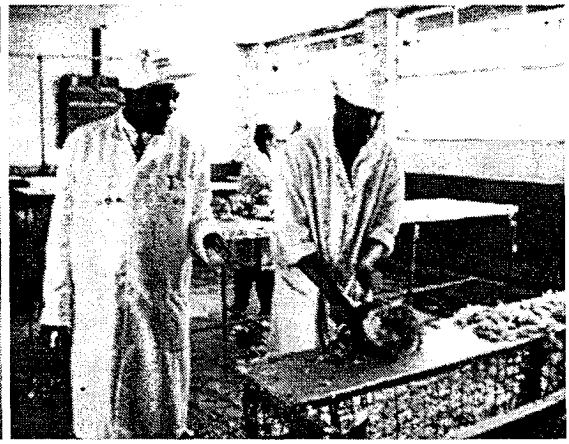
Products from these slaughterhouses are usually branded and have been able to find niche markets in major retail outlets as follows: Makueni styles:

- City market in Nairobi – 300 pieces per week
- Naivasha supermarkets in Machakos - 100 per week
- Ikuuni Hotel in Machakos-180 per week
- Heritage Hotel in Machakos- 100 per week
- Local hotels in Wote and Individuals – 300 per week
- Sultan Hamud Slaughterhouse:

These are branded and marketed by one marketing company called 'farm to plate' as branded products. These are mainly distributed to Wool Matt in Nairobi; Naivasha stores in Machakos and others non branded are sold to City Market in Nairobi and local hotels.



(a)



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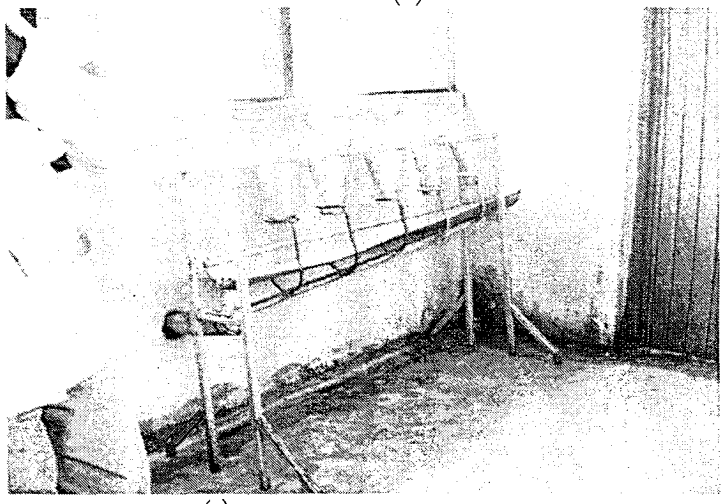
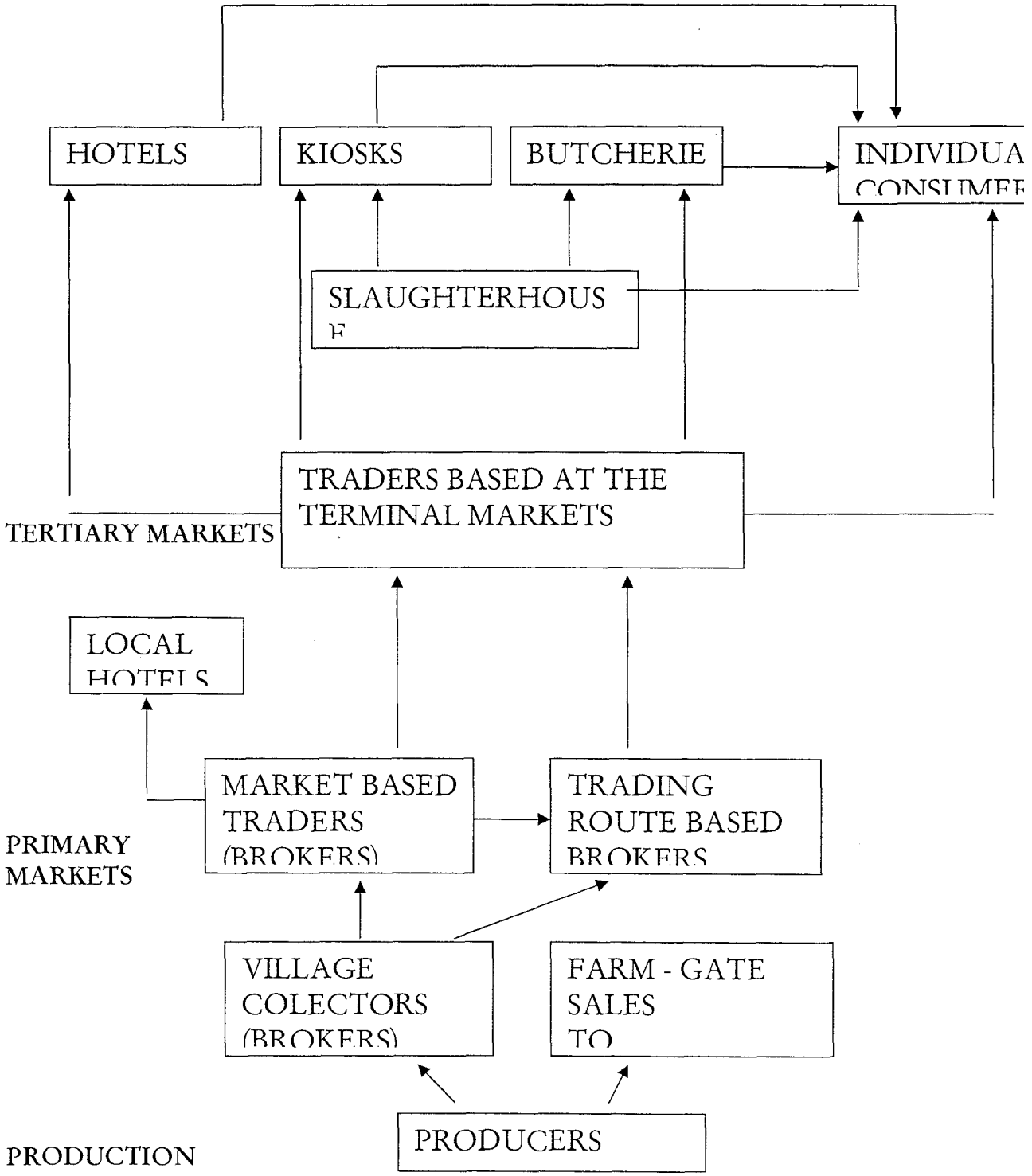


(c)

Different categories of slaughterhouses ;(a) privately owned slaughterhouse in sector 4, only used for slaughtering poultry from within the farm. 4; Public slaughterhouse owned by city council and (c) a private slaughterhouse but open to the public

Fig 2: Marketing structure for indigenous poultry



(a) Major Biosecurity issues observed in the live bird markets:

1. Poultry handling: There are no poultry handling equipment in the open air markets, Birds are normally placed on the ground. Players at the market are not aware of risks of contracting disease from birds hence they have no protection at all. In all open air bird markets visited, water for washing hands was not available

(b)

(a)

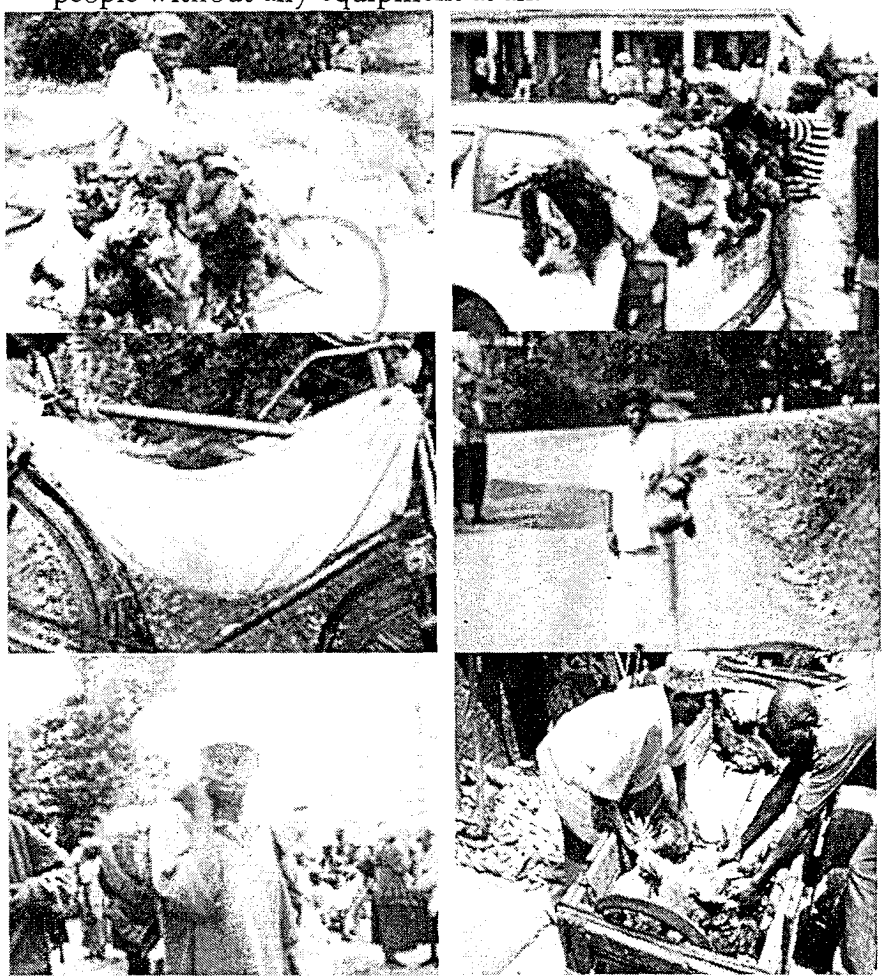
(c)

Different methods of holding birds while at the markets

Birds placed (a) on the ground in very close contact with people (b) on top of cages in the live bird markets and (c) in cages

2. Inadequate or no equipment of transporting birds to the market as well as lack of protective clothing among the players in the markets very common. The common

modes of transportation of birds to the market include bicycles with wooden crates or no equipment at all, carrying of birds in baskets, and use of public Service vehicles either in the carriers, or inside the vehicles within the same cabin with people without any equipment at all.



Different methods of transporting birds to and from the markets

3. Lack of facilities to dispose off birds that die in the markets. Some are left on the site, some traders carry them home and throw in the bush as they go home, others go to dispose at home
4. Some traders carry birds that remain on a particular market day home and mix with their flock
5. Mixing of birds from different sources from the farm level to the terminal markets. Traders have no way of determining the source As village based collectors move from farm to farm they come along with birds they had collected from the previous farms and they in some cases are allowed to handle birds at the farm as they negotiate prices. This practice is found in all the districts covered
6. There are many illegal poultry markets where slaughtering is done. In Nairobi such active satellite slaughter places include Kenyatta market, Nairobi west, Pangani, BuruBuru, Gikomba, Kayole, and Karibangi among others among others.

Burma has a slaughter slab which does not meet the required sanitary standards.

An illegal slaughter place at the backyard of a hotel

(b) **Biosecurity Issues in the Slaughterhouses:**

1. **Storage of live birds in the slaughter houses:** In all the slaughterhouses, At Sultan Hamud, Makueni styles, Thika, and Kariokor markets, birds from different sources are mixed and stored in cages awaiting slaughter. This makes it difficult to trace any problems that may arise after marketing. In Mombasa on the other hand, there is consistent recording of the cage from which birds were collected all the way up to issuing of the COT. Traders are also aware of where the bids came from, up to the name of the districts. This system can be needs to be improved to facilitate trace back.
2. **Disposal of liquid and solid wastes:** 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 burnt. However, since blood is known to cause a strong stench it is tapped into buckets for people to collect for feeding dogs along with offal which is sold for feeding dogs and pigs or for consumption by people. In the public slaughterhouses liquid waste, after cleaning the slaughterhouses is usually drained into the main sewer system. The solid waste including feathers and condemned or dead carcasses are thrown into the council bins and taken to the dump site together with other litter. The people collecting these wastes do not wear any protective clothing at all, thus risking their lives. As

far as environmental safety is concerned, this practice is not safe at all because first, at the damp sites, there are many wild birds that scavenge the litter and can potentially spread the disease. Secondly, as the dead chickens are put in the litter bins, there is a possibility that there are people who scavenge in the bins and once they find the chicken, will pick them either to slaughter and eat or sell to cheaply to hotels.

(a)

(b)

(a) A slaughter house cleaner collecting feathers fro m the floor and (b) a person preparing neck feathers for export without ant protective clothing

3. Wearing of protective clothing: Generally people handling chicken wear an over coat and gum boots. In the public slaughterhouses, only the people slaughtering will put on these, all the other players, who mainly consist of traders do not.
4. Traffic control in some of the municipal and city council slaughterhouses: in some slaughterhouses (this was observed in Kariokor and Thika); traders get in and out of the slaughterhouse to bring in or collect chicken. These traders do not wear any protective clothing and pose a risk for disease spread because they just leave the slaughterhouse and interact with public.

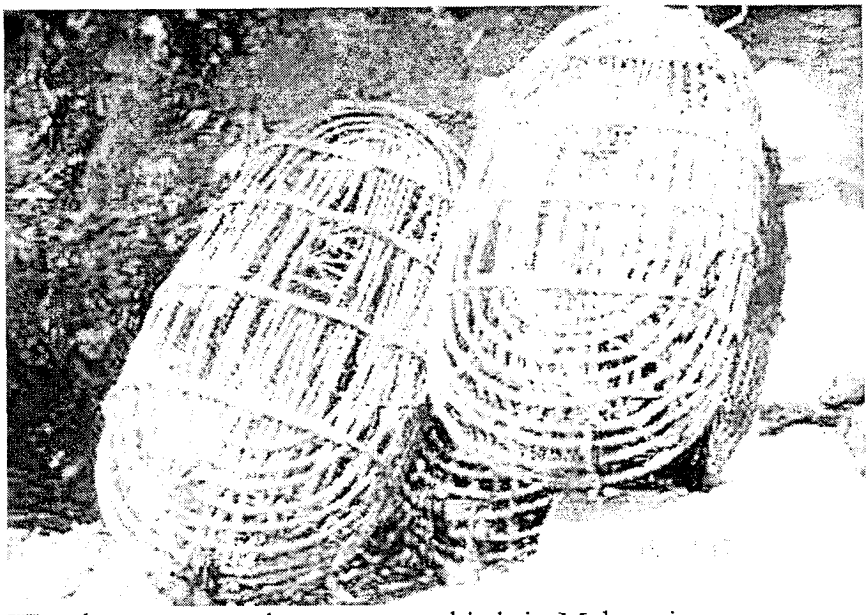
A trader inside a slaughter house collecting the slaughtered chicken

5. Unlike the others, Mombasa and Makueni Slaughterhouses have clearly separated clean and dirty areas. However in all, there is not control of workers and other personnel between the two areas. personal items were also seen all over the slaughterhouses and the terminal bird markets

3.0 BIOSECURITY ENHANCING TECHNOLOGIES

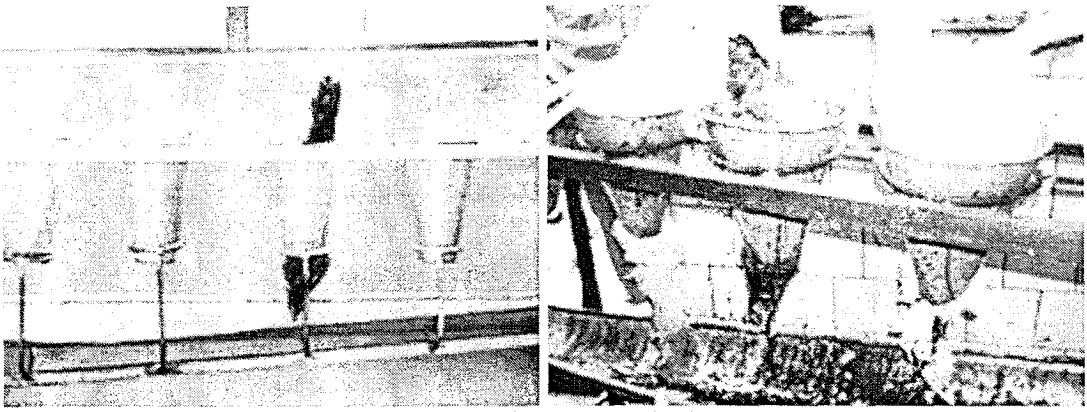
During this study, we tried to identify some technologies that farmers and other players are practicing, (with or without knowledge of their importance in enhancing biosecurity) which can be improved or up scaled for possible adoption. Presence of such practices clearly indicates that farmers and other players are innovative and if guided, they can come up with very unique technologies that are compatible with their economic and social realities. This is an opportunity that service providers should exploit to promote safe poultry production and marketing. Such technologies include:

1. Substitutes for disinfectants:
    a. Sprinkling Magadi soda on a damp sisal gunny bag at the entry to the poultry house and around the house to serve as foot disinfectant: Magadi soda is readily affordable by most small scale farmers as compared to conventional disinfectants. The efficacy of Magadi soda should however be analyzed and if found satisfactory, the technology should be up scaled along with appropriate guidelines for use.
    b. Sprinkling of wood ash at the entrance into the poultry house and around the house as a disinfectant and also to keep off ecto parasites. This, as in the case of Magadi soda, should be analysed and if appropriate, up scaled along with guidelines
2. Safe euthanasia methods: While at home most farmers slaughter and bleed chicken using methods that cause contamination of the surfaces with blood, at the slaughterhouses (Nairobi, Thika, and Mombasa), there are people who are specialist in safe slaughtering. This method ensures all the blood collects in the head. Evisceration is also done with minimal contamination of surfaces. This method should not only be promoted at household level, but practitioners of such euthanasia methods should be identified for possible recruitment should there be an outbreak and people to do actual culling are required.
3. Wooden cages for transporting birds: Transportation of birds by traders especially at primary and secondary bulking is a big challenge in protecting people handling birds from infections. In some areas, farmers have devised wooden 'crates which are tied on bicycles to transport birds from villages to the markets .Farmers should be guided on the carrying capacities for a given size of crates to stop overcrowding. These will be offer solutions to the problem of transporting birds with bare hands as it is currently done in many parts of the country.



Wooden crates used to transport birds in Makueni

4. Use of Jua kali funnels to restrain and bleed birds in the private slaughterhouses. This technology ensures blood collects on the funnel and is safely disposed. This technology should be promoted in the municipal and city council slaughterhouses



Metal funnels for restraining and bleeding of birds during slaughter;

4.0 CHALLENGES FOR IMPLEMENTATION OF BIOSECURITY PRACTICES:

1. Social cultural reasons: Mainly affect practices that facilitate interaction between human and birds such as poultry housing and handling; beliefs such as poultry diseases cannot be transmitted to humans hence it is safe to consume sick or dead birds, importance of social festivals such as cock fights in which the wining cock cannot be slaughtered but should be taken back home; belief that once you are given a chicken as a gift, you should carry it alive as this is a sign of appreciation ;Use and donation of live chicken for social functions such

as funerals (*matanga*), hence movement of birds across villages; when a chicken is slaughtered at home, offal are left for children who are supposed to prepare for themselves, making them vulnerable to contracting diseases

2. Ignorance and attitudes: There is a general feeling that Biosecurity practices are very expensive to implement; birds especially in sector 4 are not so significant to involve a vet or even report of their diseases; that herbal treatments are more effective than the conventional drugs; taking visitors into poultry premises in order to show off one's flock; farmers do not attend training seminars because they claim to be busy somewhere while most of them are not even aware of HPAI, its spread and control
3. Economic Factors; these were implied as cost of disinfectants; protective clothing; cost-effective methods of transportation of live birds to markets or slaughter houses especially in sector 4;
4. Indian crows which roam along the coastal strip are a menace as far as disease control is concerned. The crows come with ships to the East African coast and start breeding in trees along the coastal strip. Some trees such as baobab trees are known to harbour thousands of them. They are believed to be very migratory, they can sleep in one division in a given district, and by mid day they can move to another district to feed and later in the evening move to another place. They are difficult to control and a farmer who is licensed to shoot them confessed that it takes 25-30 rounds to shoot only ten of them. Efforts to trap them in cages are futile as they are too 'clever' to fall into the traps. The KWS policy is to control and not to kill them
5. Institutional and infrastructural limitations: inadequate number of veterinarians to inspect birds during slaughter and to enforce laws on movement; cooperation from owners of slaughterhouses in maintaining the required sanitary standards in the slaughterhouse including proper disposal facilities at the live bird markets; city and municipal councils not providing specific sites for live bird markets for enhanced biosecurity at the markets; limited infrastructure and facilities for vaccine distribution
6. Illegal trade across the boarder, relatives from each side of the boarder bringing in chicken especially whenever there are social functions such as burials *(matanga)*. Kenyan traders at the boarder town prefer to buy chicken from Uganda because the prices are better. (Some of the respondents at the live bird markets in Busia were actually Ugandans who had come to sell chicken in Kenya.) Sometimes whenever there is an outbreak of a disease in Uganda; traders bring them into Kenyan markets. Discussion with key informants also revealed that some of the eggs coming to Kenya through the Busia boarder usually come from South Africa
7. No slaughterhouses in many poultry producing areas hence a lot of movement of live birds across regions and home slaughter for majority of broiler farmers. For instance birds that come to Nairobi come from as far as Kericho, Bomet, Makueni, Kitui, Molo, Laikipia, Thika (Highest supplier of spent layers) and Wangige (spent layers). It is important to note that other than facilitating

spread of diseases, the live bird system of marketing and hawking of birds (road side selling) enhances poultry theft , hence necessitating many farmers to share shelter with birds

4.0 CONCLUSIONS AND RECOMMENDATIONS

Poultry industry is a significant economic activity in Kenya, providing incomes to many players in the value chain and supports other sectors of the economy. In rural areas, it plays a decisive role in enhancing food and nutrition security and improving livelihoods of poultry owners. For this to be well understood there is a need for an economic study to adequately quantify the contribution of this industry into the national economy. The four poultry production sectors are well represented in the country, but variations in terms of implementation of biosecurity practices conspicuously exist within each sector (except Sector 1 which is represented by one company). Sector 3 and 4 require special attention due to their high vulnerability to disease incursion and the weak biosecurity levels. While sector 3 largely interacts with all the other sectors especially in the acquisition of inputs, Sector 4 is the most insecure and its products especially live birds are moved both within and between regions posing the biggest threat for spread of diseases. In the event of an outbreak the of HPAI, movement control should therefore be the first and most important measure to take to limit disease spread This is a big challenge which calls for recording and documentation systems to enhance traceability of birds in markets or those in transit. Social, cultural, economic, Institutional and lack of awareness were cited as major factors responsible for the current biosecurity status. The following recommendations will help address these factors and therefore improve biosecurity in the poultry industry at large:

1. Farmer training: This must be a priority in order to deal with wrong attitudes/ ignorance and to elicit behaviour change required to deal with the social cultural factors and to give farmers economical reasons for implementing biosecurity practices in their farms. Trainings should include general awareness on HPAI, how it is spread and control measures; carcass disposal; methods of treating poultry litter for feeding cattle and fertilizer; general hygiene in a poultry house; how to separate old and new birds; quarantine of sick birds; training and awareness creation should involve all methods including producing print materials for farmers containing the necessary information
2. All stakeholders who have some interest to protect in the poultry industry should be brought on board so that effective and sustainable strategies for reaching farmers can be developed. The role of input suppliers (hatcheries, millers, and pharmaceutical companies), private animal health service providers, municipals and city councils, private investors (slaughterhouses) and agro vets was emphasized in all the group discussion in the district visited. These players should therefore be involved in all the matters affecting farmers who are their main clients so that they can integrate the intended activities in their plans. The role of local authorities in

improving biosecurity in the live bird markets and slaughterhouses as well as addressing the issue of rearing birds in the slums cannot be overemphasized. All players should be regularly updated with Avian Influenza information.

3. Awareness creation to the general public; after the avian Influenza scare of 2006, we learnt that many people have heard about HPAI but have already forgotten about it. Hard facts about HPAI, its spread and prevention measures were largely lacking among the many people interviewed. Information on safe handling including slaughter; the need to insist on inspected meat in order to reduce the risk of consuming chicken of questionable quality as was reported that some of dead chicken finds their way to hotels. Chief barazas and periodical broadcasts on AI through mass media could be very important in creating consumer awareness
4. Institutional capacity building and reviewing of policy issues: Strengthening of poultry inspection in the hotels, slaughter places, markets, and points of entry. The department of veterinary services should devise a sustainable vaccination system for NCD especially in sector 4 which was found to be largely inadequate.
5. Stakeholders' forum that already exists at the boarder should be involved in surveillance for AI. Members of SH forum at Busia Boarder who include the police, immigration department, municipal council, Agriculture , fisheries, KEPHIS, customs, Public health should be sensitized on AI so that they can effectively play this role.
6. The department of veterinary Services should provide and enforce standard guidelines which should be applied across all the hatcheries.
7. In sector 4 the biggest risk of introduction and spread of a disease is through movement of birds both for social functions as well as during marketing. Movement for marketing purposes involves large number of birds and across different regions, and therefore requires special intervention for trace back. There is an urgent need to develop a system of labelling birds from different sources for traceability, at least up to the divisional level. Along with this standards should be developed and enforced by the department of veterinary services on transportation of live birds in order to minimize the risk of spreading diseases and to promote humane handling of birds.
8. Development or improvement of the existing biosecurity enhancing technologies using locally available materials. The extension and the field veterinary staff should respond to the emerging poultry diseases by shifting from recommending standard technologies which, because of the cost implications, are not applicable to the small scale nature of the Kenyan production systems. This would require participatory approaches so that farmers can be involved to innovatively find suitable practices within their economic and social realities.