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Strategies for the Prevention and Control of Infectious Diseases (including Highly Pathogenic Avian Influenza) in Eastern Africa

GOOD BIOSECURITY PRACTICES IN SMALL SCALE COMMERCIAL AND SCAVENGING PRODUCTION SYSTEMS IN KENYA

Scavenging village chickens

Elevated village chicken house

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TABLE OF CONTENTS

LIST OF ANNEXES

PREFACE

Ever since the outbreak in Hong Kong in 1997 of Highly Pathogenic Avian Influenza (HPAI) caused by H5N1 subtype in poultry and the deaths of six of the infected workers, an unprecedented spread of poultry and human infections by this subtype have occurred from year 2003 to date from South East Asia and China to reach the Middle East, Europe and Africa. This spread is believed to have occurred through migratory wild birds. In Africa, Sudan and Djibouti first reported outbreaks; followed in February, 2006 by Nigeria and subsequently most countries close to Nigeria have since reported outbreaks. Other subtypes of avian influenza viruses, especially H7N7 and H7N3 that have been reported to have infected humans continue to cause severe disease in many countries of the world with enormous economic and socio-cultural consequences. Further spread in Africa is very likely to occur. Once these outbreaks occur, they pose risks to human infection, disrupt production, marketing, processing and distribution of poultry and their products and destabilize livelihoods of vulnerable groups as well as many other socio-economics activities.

While sectors 1 and 2 farmers observe varying levels of bio-security the sector 3 and 4 farmers practice less if any. They are most likely to have difficulties and vulnerabilities in the event of an outbreak of avian influenza infection. In order to produce safe poultry, provide improved bio-security practices, allow the development of strategies and measures that encourage sustainable poultry production and effective disease control, a study of bio-security issues in sectors 3 and 4 is essential.

Such a study would provide a good understanding of the entire production system, and all the relevant practices undertaken by poultry farmers and traders and identify possible bio-security flaws and likely vulnerabilities in the livelihoods of the poultry farmers and consumers of poultry products; the possible routes through which birds may acquire avian influenza infections in non- infected countries and areas of potential exposure to humans.

The study would also help countries to develop appropriate control measures and improved bio-security. This report describes a review of the bio-security and husbandry practices and systems for Sectors 3 and 4 to prevent HPAI infection in Kenya. It is part of a series of Country Reports that are commissioned by the Animal Production Service (AGAP) of the Food and Agriculture Organisation of the United Nations (FAO) for the Emergency Centre for Transboundary Animal Disease (ECTAD).

We hope this report will provide accurate and useful information to its readers and any feedback is welcome by the author and the ECTAD Team.

EXECUTIVE SUMMARY

Although Kenya is on the migratory flyway for birds flying from Siberia through the Middle East and moving along the great Rift Valley to Southern Africa, it has not yet experienced avian influenza infection. However, the risks of exposure are very high given the fact that outbreaks have and continue to occur in Egypt which lies directly along this flyway and that Kenya has very many wetlands where migratory birds can land. It is therefore appropriate to assess the possible bio-security flaws that may arise in the more vulnerable poultry production systems of sectors 3 and 4. In this regard FAO commissioned a study of the Kenya poultry sector analysis to identify the potential bio-security risks and lay a basis for developing guidelines for bio-security interventions.

Biosecurity principles include simple procedures and practices which when applied prevent entry of disease agents into a farm or the exit of the disease agent from infected premises. This may involve protocols, practices, and manouvres to ensure that clean flocks remain free from entry of disease agents and that disease agents remain confined in infected flocks and do not spread to other premises. It includes controlling movement of stock, persons, equipment and products into the clean farm and out of infected premises; and finally it involves methods that enable farm to remain in a state of sustained cleanliness, referred to as sanitation.

Commercial layer and broiler chicken farmers obtain their day old chicks from in-country hatcheries while farmers keeping indigenous chickens source their original breeding stock from a neighbour or from the market. Currently it is easy to obtain broiler day old chicks but one has to wait for at least eight months after booking to get layer chicks. Importation of day old chicks from infected countries has been banned. This has disrupted placement programmes of the local hatcheries since they are unable to import day old chicks from the traditional sources that they are used to. While some of the houses in sector 3 are made of washable walls and floors, most of the houses in sector 4 are difficult to clean and decontaminated.

The broiler and layer chicken houses should conform to the ideal recommendations given above. However, the important point to remember is that the house should be cleanable easily; should reduce wind chill and provide adequate ventilation, sunshine and sunlight. Laying boxes should be provided. The houses should facilitate parasite and disease control. They should promote faster growth and protect the chicken from predatory birds and animals and adverse weather conditions and theft during the night as well as during the day time. On the other hand houses in sector 4 vary very markedly. However, irrespective of the type of house they should observe some minimal criteria, namely: the houses must have enough space for the number of birds to be kept in the house so as to

avoid over-crowding and other vices that emanate from crowding; the houses should kept dry, clean and well ventilated; and the should have adequate sunshine and lighting.

Whether the farmers keep commercial or indigenous chicken, they should be conversant with the best methods that promote safety, good growth and optimal productivity of the chicken. This would also create awareness of the possible flaws that may occur if improper husbandry practices are done. One of the greatest break-throughs in dealing with bio-security issues will occur when a farmer realizes that what he or she has been convinced about in the past to be a very good and correct manner of raising their birds actually predisposes not only the flock but also the farmer and his whole household to disease. The farmer will have reached a turning point towards good husbandry practices. But this will take a lot of careful teaching and training using a language the farmer can identify with and relate to his or her daily life.

While the feeds for commercial birds is generally good in quality and the supplies are adequate, the indigenous chickens scavenge for their own food in the environment and they are more likely to get sick from disease agent brought about by wild birds or animals. The feed would be a source of disease to the commercial birds if it was itself contaminated with the disease agent.

Commercial layer and broiler flock are routinely vaccinated against common diseases found in the country. However, most indigenous chickens are not vaccinated except in areas where special programmes have been run that show the farmers the value of protecting birds from disease and the ensuing increases in productivity. Newscastle disease has been used as an example in some villages of one location where those who vaccinated their birds did not loose any of their birds while the disease wiped out all the chickens in the villages that did not vaccinate.

There were many bio-security flaws identified at different points along the value chain from the farm to the consumer where disease could be spread between birds and to humans. Live bird markets, slaughter houses and dry and wet methods of plucking feathers were particularly weak areas likely to lead to disease spread. Disposal of manure, dead birds and slaughter waste are other areas to be looked at carefully.

Persons constantly exposed to high concentrations of poultry dust and aerosol, for example those in live bird markets, slaughter houses, poultry houses and meat processing handling poultry were identified as being at high risk of contracting avian influenza disease. Simple procedure like washing hands and personal hygiene will reduce chances of getting infected.

ABBREVIATIONS

FAO	= Food and Agriculture Organisation of the United Nations.
H5N1	= Avian influenza of hemagglutinin subtype 5 and Neuraminidase subtype 1
HPAI	= Highly Pathogenic Avian Influenza.
ECTAD	= Emergency Center for Transboundary Animal Diseases
AGAP	= Animal Production Service of the Food and Agriculture Organisation of the United Nations (FAO)

1.0 INTRODUCTION

1.1 General background

The Kenya land mass covers a wide range of topographical and climatic zones from the tropical coastline to temperate highland areas and arid and semi-arid areas in the North and Eastern parts of Kenya as well as the fresh water lakes in the Great Rift valley and the largest fresh water mass in Africa, Lake Victoria (Nyaga,2007b). There are both resident and migratory birds that may mix with domestic birds and probably introduce avian influenza into the domestic flocks. Currently, Kenya is free from highly pathogenic avian influenza (HPAI) H5N1.

However, with the global spread of highly pathogenic avian influenza (HPAI) and its entrance into African countries, there is every reason to be concerned with how effective preventive measures can be instituted in all sectors of the poultry industry in Kenya. Although Kenya has not yet had any outbreak of HPAI, there was an avian influenza scare in the 2005/2006 period which had adverse impact on the poultry industry and the families dependent on poultry for their livelihoods (Kimani, et al, 2006; Nyaga, 2007a; Nyaga 2007b). It would have been very good if any flaws in the bio-security in any of the production systems( )had been identified. This would have allowed the government agencies to institute targeted interventions to prevent entry of HPAI or to quickly contain an outbreak in the event the virus enters the country. Therefore, there is a concerted effort by the Kenya Government and the International Community to understand the extent and nature of bio-security flaws and possible interventions in the commercial and indigenous poultry productions systems which in Kenya have now been classified into sector 3 and 4, respectively in a recent FAO commissioned poultry sector analysis study report (Nyaga, 2007b). In this regard the FAO has initiated efforts to gather all available information which is relevant to bio-security in the operations of sectors 3 and 4 in Kenya.

Therefore a study was commissioned entitled, " **Bio-security review and improved poultry husbandry systems for Sectors 3 and 4 to prevent HPAI infection: A poultry sector analysis in Kenya**" The information collected will be used to make recommendations and develop guidelines for safe poultry husbandry and improved bio-security practices in Kenya and thus prevent HPAI and other disease outbreaks.

1.2 Definition of bio-security

In order to have a common understanding on the issues at hand when dealing with questions of bio-security in the different poultry production systems and also when dealing with the humans aspects of the avian influenza outbreaks a discussion on the definition would be a good

starting point. **Bio-security** refers to the ***implementation*** of **policies** and **practices** that **prevent** the **introduction** and **spread** of disease.

In Kenya viral, bacterial, fungal and parasitic infectious disease affect poultry in each of the sectors (Bebora,1979; Goje,1993). The major viral diseases in order of importance are: Newcastle disease(Gitao, C.G.,1996; Kasiiti, 2000; Musiime, 1991; Njue etal, 2002; Nyaga, 1982; Nyaga etal 1985); infectious bursal disease (Ndanyi, 2005); fowl pox; Marek's disease; avian leucosis; epidemic tremour, while the bacterial diseases are fowl typhoid and Salmonellosis (Bebora,1979; Bebora and Nyaga, 1989; Bebora etal, 1998; Karaba, 1992); colibacillosis (Karanja, 1998), infectious corrhyza, fowl cholera (Mbuthia, 2001; Mbuthia, 2004; Mbuthia, 2005a,b,c) and mycoplasmosis. Coccidiosis is very common in sectors 2 and 3 and to some extent in sector 4. When Newcastle disease is eliminated from a flock through vaccination, other diseases seem to appear in the indigenous poultry. Infectious bursal disease prevalence is fairly high in sectors 3 and 4.

There are three bio-security principles that are involved in the management and control to prevent the entry of disease into a flock or the spread of disease from infected premises (Cardona, etal, 2007; Nyaga, 2007b), namely:

- **Isolation** of premises and poultry from sources of infection. This would include such practices as keeping different bird species separately; preventing exposure of birds to potential sources of disease; preventing introduction of new birds from live bird markets or neighbours into an old flock; quarantining new birds for a period of time before letting them join an older flock; quarantines in the event of a disease outbreak in a farm; not returning home any birds that left the home for sale or show to come back into the same flock houses or not returning trays that went to the market back into the flock house before they are decontaminated; identifying clean and dirty operations in the farm and starting with the clean and ending with the dirty operations; identifying dirty and clean operations in the slaughtering process and preventing contamination of the final product from the dirty operations; preventing wild birds and animals or domestic pets from contacting the flocks. All these measures lead to both bio-exclusion and bio-containment of disease agents thus preventing spread of disease.
- **Controlling traffic** flow in and out of susceptible areas to limit exposure. This would include fencing, gates, human and vehicle controls within the farm and into the farm; notifying the visitors that flock areas are out of bound to outside visitors; controlling movement of equipment and products to and from the farm.
- **Sanitation** of equipment, housing, protective clothing for poultry workers, and sustaining personal hygiene that will lead to

destruction of disease agents. This would entail the washing of hands; using fresh or dedicate clothing exclusively for the chicken house for sector three and four cases; using personal protective equipment like coveralls, gum boots, headwear; cleaning and disinfection of vehicles, houses and equipments; using showers and fumigation and frequent washing of hands before and after handling poultry or their products.

- Overall the intention of bio-security measures is to ensure both **bio-exclusion and bio-containment** of the infectious agents to prevent infection of clean flocks and prevent spread of disease from infected premises, respectively.

The bio-security study in sectors 3 and 4 will therefore involve evaluating the inclusion or omission of measures directed at ensuring that these principles are fulfilled in the poultry operations being assessed.

2.0 SOURCE OF STOCK

2.1. Standard Requirement

Commercial layer and broiler farmers are expected to obtain their day old chicks from the hatcheries in Kenya or import from sources that are approved by the veterinary authorities in Kenya. This is regulated to prevent importation of infected chicks. However, the indigenous farmers are expected to make their own arrangements to source their starting stock from whatever internal sources they may determine. Whereas the sources of stock for the commercial birds is regulated by law (Government Printer, Laws of Kenya), that for the indigenous farmers is not.

2.2 Actual/Current situation in Kenya

The **commercial layer and broiler** day old chicks are obtained from the four main hatcheries in Kenya, namely: Kenchic, Muguku, Sigma and Kenbrid hatcheries (Nyaga, 2007b). There are smaller hatcheries that supply chicken to local farmers in places where the hatcheries are located but the numbers are not significantly large. Each farmer would go to the respective hatchery and book the number and type of chicks they need. It is easier to obtain broiler chicks than it is to get layer chicks for example, currently (Year 2007) to get layer chicks, one may have to wait for eight to ten months after booking. However, one can get broiler chicks readily. There are two hatching days in each week when the farmers can access the day old chicks from the hatcheries.

On the other hand, farmers keeping **indigenous chickens** hatch their own day old chicks from eggs that have been incubated by brooding hens in the farmer's home. The original breeding stock may have been sourced from a neighbour as a gift or sold to the farmer; or purchased from the local market; it could have been a gift from friends or relatives.

2.3 Bio-security situation

For the **commercial birds**, there is a ban on importation of poultry and poultry products from countries that have reported H5N1 HPAI and this has placed very heavy constraints on the production programmes of the Kenyan hatcheries. This is because they cannot import day old breeding chicks from their traditional sources of Britain, France, Israel, Italy, India and China. There are strict controls at the ports of entry to make sure that no day old chicks or any poultry products enter the country. In this way, the ban has sustained an avian influenza free status in Kenya so far since it is possible that if day old chicks were imported, whether legally or illegally from any of the infected countries, the avian influenza virus might have been imported into the country too. However, there are some common bacterial infections like those due to *Escherichia coli*, *Staphylococcus aureus, Pseudomonas aeruginosa, Proteus vulgaris, Streptococci spp* and other bacteria that affect day old chicks and they arise from the brooding environment (Maina,1988); or from the hatcheries (Bizimenyera,1986; Bizimenyera, et al, 2001; Bizimenyera, et al, 2004).

At times some farmers transport the day old chicks from the hatchery in the same vehicles that had taken eggs to the market or that had gone to transport feed to another farm and the egg trays are still in the vehicle that is now to be used to carry the day old chicks.

For the **indigenous chickens**, the greatest biosecurity problem for the day old chicks is the exposure they get to the dirty environment where the adults, growers and other chicks that hatched earlier are already living and soiling the area with their fecal matter.

2.4. Recommendations

For the **commercial flocks**, it is recommended that the protocols and procedures in the hatcheries be monitored regularly to assure they supply clean day old chicks free from bacterial and viral agents that may emanate from hatcheries, e.g. *Escherichia coli*, *Staphylococcus aureus, Pseudomonas aeruginosa, Proteus vulgaris, Streptococci spp* and other bacterial agents that cause mortalities in young chicks in the first 14 days of life (Karanja, 1998; Maina, 1988). Use of appropriate disinfectants in the hatchery and in the brooding house is recommended. Day old chicks should be carried and transported from the hatchery to the farm should be dine in clean chick containers and vehicles.

For the **indigenous chickens**, provision of clean beddings for the brooding hen and provision of a clean separate area away from the other birds where it can brood the chicks at least for the first two weeks will be useful.

3. HOUSING

3.1. Standard Requirements/Ideal

Broiler houses should protect the birds from strong winds and drafts and protect the birds from thieves at night or day; predators, rodents, mongoose, wild cats and birds; to provide good ventilation; to make it possible to thoroughly and easily clean the houses; to provide enough sunlight and sunshine and adequate drainage so that the poultry house remains dry. If possible the orientation of the house should allow proper lighting, sunshine and prevent wind chills. The housing should provide adequate space for birds in general 3- 4 square feet per birds – for layers and 1 square feet per bird for broilers (Ngugi, 1980).

Adequate feeding troughs and watering equipment have to be provided for both broilers and layers and laying nests for the laying houses. The size of the house will depend on the number of birds to be kept. The houses are to be permanent or temporary structures and the building materials will vary. The materials should provide the conditions given above, for example: when iron sheets are used to build walls, the house can be easily cleaned but it is very cold during cold weather and hot during the hot season. Grass thatch will provide very good insulation from both heat and rain, but they are a good resting place for rodents, insects and in case of fire they ignite easily. Most houses are roofed with corrugated iron sheets.

3.2. Actual/Current situation in Kenya

The **broiler houses** usually have earth floors but half of the walls are wire netting while the bottom half is made of mud walls, wooden planks, iron sheets or stone walling depending on the financial ability of the farmer. Corrugated iron sheets are normally used for the roofing. Wood shavings are used for the deep litter and water is supplied in commercial drinkers or home made drinkers both manually filled with water. The roof is supported by wooden posts (Fig.2.1). Feeders are wooden troughs, plastic or metal commercial feeders placed conveniently in the poultry house.

The floor in some of the broiler houses may be made of cement (Fig.2.2).

Figure 2.1. Broiler house with chicks

Figure 2.2.Cement floored broiler house after cleaning.

The general structure of the **layer houses** are the same as for the broilers except that laying boxes are now provided and that there is more space per square foot per bird for the layer houses compared to the broilers houses. The houses usually have earth floors, the bottom half of the walls is made of stone, iron sheets or wooden planks (Fig. 2.3) while the top half is wire netting and the roofs are iron sheets. Some houses have two floors, one ground floor and an upper floor. Where the land size is small the two floor houses maximally use the available space effectively. Drinkers and feeders may be home made for those farmers with small size flocks and are made from cut out 20 liter jerry cans for drinkers and wooden troughs for feeders. Those farmers having larger layer flocks may have commercial plastic drinkers and feeders. All the layer flock houses have wood shaving deep litter beddings. The wood shavings usually decay to powdery manure by the time the layers stop laying and are to be depopulated at the age of 18-24 months. Water is provided for in metal containers; plastic drinkers; plastic basins or home made cut-outs of 20 litre plastic jerry cans (Kantengwa, 1988; Fig. 2.4).

Fig.2.3. Wooden layer house.

Fig. 2.4 Drinker

Fig.2.5 Chicken scavenging

There are no footbaths in most of these farms. Poor personal hygiene, particularly the practice of not regularly washing hands, wearing of domestic clothes in the poultry house, not wearing gum boots and not wearing head covers leads to potential entry of disease in the flocks.

Regarding **housing for sector 4**, it is difficult to give a common structure, particularly remembering that majority of the farmers are not keeping the birds as a commercial enterprise. They therefore invest very little into the poultry enterprises in the way building very permanent houses and build poultry houses of differing shapes, sizes and made of varying materials (Fig 2.6A-F). One must observe that the designs of these sector 4 houses have special characteristics that ensure: safety of the birds from animal predators; provide good ventilation, good sunshine and sun light; and give a good and safe nesting place for hens.

There are many bio-security risks here. Note the wooden walls, wooden posts on the elevated houses (Fig.2.6A, B, C, and F) and the earth floor in Figs. 2. 6D, E). Poultry waste falls directly into the environment.

Figure 2.6A

Figure 2.6B

Figure 2.6C

Figure 2.6D

Figure 2.6E

Figure 2.6F

Figure 2.6A-F Showing different types of houses in sector 4. No mud houses are seen here (Courtesy of Kenya country FAO poultry sector analysis report, Nyaga, 2007).

3.3. Recommendations

The **broiler and layer** chicken houses should conform to the ideal recommendations given above. However, the important point to remember is that the house should be easily cleanable; should reduce wind chill and provide adequate ventilation, sunshine and sunlight. Laying boxes should be provided. The houses should facilitate parasite and disease control. They should promote faster growth and protect the chicken from predatory birds and animals and adverse weather conditions and theft during the night as well as during the day time.

A disinfectant dip should be placed at the door of each house to prevent entry of diseases agents into the flock house. In addition, the houses should be properly cleaned and decontaminated carefully after the litter has been removed and the houses have been well swept. The social-

cultural behaviour of farmers of showing off their well kept flocks exposes birds to potential entry of diseases and it should be avoided by enclosing the flock houses so that they are not accessible to visitors. Dedicated clothes should be worn in the poultry house and this would reduce chances of entry disease into the flock houses

Since **houses used to keep sector 4** poultry vary so much in construction materials, sizes and shapes, it is difficult to give a recommendation of a common structure; particularly considering that majority of the farmers do not usually keep the birds as a commercial enterprise and most of them have a low resource base. They therefore invest very little in building poultry houses. However, irrespective of the type of house they should observe some minimal criteria, namely:

- Houses must have enough space for the number of birds to be kept in the house so as to avoid over-crowding and other vices that emanate from crowding.
- Houses should kept dry, clean and well ventilated.
- Houses should have adequate sunshine and lighting.

4. HUSBANDRY

4.1. Standard requirements/Ideal

Ideally, any **commercial layer and broiler poultry farmer** should have basic skills in the management of broiler and layer flocks. This would include brooding of day old chicks where adequate warm, water and feed are need. They should give water at first to the day old chicks on arrival in the brooding house. The wood shavings should be warm to the right temperature prior to the arrival of the day old chicks. Adequate water and feed supply are required (Ngugi, 1980). Many bio-security risks arise in this area, particularly in the watering and feeding equipment (Kantengwa, 1990). These are supposed to be clean and disease free.

On the other hand many of the farmers keeping **indigenous chicken in sector 4** are not ordinarily expected to have been exposed to any training. However, they are free to join any training course that may be promoted in their region. The birds scavenge for feed in the compound and may or may not be supplemented with additional feed grains. In this regard, they are exposed to dirty or soiled water and feed at all times.

4.2. Actual/Current situation in Kenya

In Kenya, most of the **commercial poultry farmers** have had some exposure to the proper husbandry techniques needed for brooding and growing broiler and layer birds. The training is done by the hatchery

personnel, extension officers and non-governmental organizations and at the farmers training centres.

Most farmers keeping **indigenous chickens** do not get any training on husbandry practices except the few who may have formed farmer associations and are being encouraged by special business groups to keep chickens as a business and are therefore being given some training. Most farmers would then do the rearing using their own home-grown skills. There are many bio-security risks here in the sense that the farmers may not observe any personal hygiene, that they may keep birds of different ages all together, and that some farmer would house their birds in the same house as the human beings. None the less the birds are left to scavenge for feeds anywhere in the compound and there they may encounter disease agents including contact with wild birds, other domestic and wild mammals and dead birds that may have been disposed in the farm compound.

During the scavenging process (Fig. 2.5), the birds are exposed to dirty or soiled water and feed all the time which can act as a source of disease.

4.3. Recommendations

Training in good husbandry practices for all the farmers in both sectors improve bio-security measures markedly. This could include proper timing of feeding; use of clean water and watering equipment; use of clean feeds and proper disposal of dead birds; cleaning of houses, coops, and the use of clean foot wear and clothing; and keeping of good records will assist the farmers to reduce the bio-security risks found during husbandry practices in both sectors 3 and 4. Brooding and rearing practices for layer and broiler chickens that expose them to bio-security risks that increase their chances of contracting disease should be avoided. For example using one brooding house for different ages of birds will expose the younger birds to a dirtier environment that could lead to illness.

All attractants that may draw wild birds to the farm should be removed, e.g. spilled grains, open water spots, dead carcasses and trees that may act as nesting sites for wild birds. Trees provide shade for the birds when the sun gets very hot and their removal is likely to be controversial and therefore the removal needs to be considered with more care.

5. FEEDS AND FEEDING

5.1. Standard Requirements/Ideal

In **sector 3**, there are standard feed requirements and feeding regimes which are recommend and the feeds are manufactured locally for layers and broilers and these standards must be adhered to if good results are to

be obtained (Nyaga, 2007b; Ngugi, 1980). The following feeds are recommended: chick and duck mash, growers mash, and complete layers mash feeds are give to commercial layer flocks; while broiler starter mash, growers and finisher mash are give to broilers at the respective growing stages. However, irrespective of the type of feed type that is purchased for the chicken, it is necessary that the feed provides a balanced diet for the ages and types of birds being reared. The feed must have adequate energy, protein, minerals and vitamins for the respective age for which it is formulated and be free from disease.

Regarding sector 4, there is no standard requirement for the scavenging birds which meet their nutrient needs by gathering different types of feed materials that they can get from the environment.

5.2. Actual/Current situation in Kenya

There are many feed millers in Kenya and the chicken feed is generally of good quality. There is also a good supply of both layer and broiler feeds for the different age groups to be reared. Many feed shops also keep supplementary mineral and vitamin preparations which can be given to the birds in the case of stress.

Bio-security risks arise from the possible contamination of the feed with disease agents either by the feed being exposed to fecal material from sick birds; rodents invading the feed store whereby the feed gets contaminated with rodent urine and fecal matter containing disease agents; or if the feeding equipments are left outside for some time they get contaminated with fecal matter or dust laden with disease agents. Water that is contaminated with disease agents will also make the birds to be sick.

On the other hand, **indigenous birds** get their feed by scavenging for insects and wasted grains scattered in the farm, food left-overs and green vegetation and finally water from rain water pools in the compound or supply of water in an open container kept outside by the farmer for all the birds. During confinement in the rainy season, the indigenous birds may be given supplementary feeds in the form of whole grains, maize bran or kitchen left-overs. Water is also given to the birds in the place where they are confined. Many times the confined birds are in very poor nutritional status towards the end of this season. However, they recover soon after they are released from confinement for there is then plenty of feed to scavenge in the farm.

Bio-security risks arise from the places where the birds get the scavenged feed resources from since these areas are all exposed to the atmosphere and the environment where contamination with disease agent may have got in from wild birds and animals or dead birds or manure disposed from a neighbour.

5.3. Recommendations

Well balanced fresh feeds should be available to feed commercial layer and broiler feed. The feed should be free from disease agents and should be kept in a clean, dry store free from rodents and insect pests. The feeders and waterers should be cleaned and disinfected properly with an approved disinfectant. The feed gunny bags used to package the feeds should not be recycled, and if this is done then they should be thoroughly cleaned and decontaminated.

The indigenous birds need to be provided with clean water and the receptacles where the feed and water are put be cleaned well and be disinfected (Njagi, 2003; Njagi etal, 2004a,b; Njagi, 2005). The compound should be free of dead birds. The supplementary feed should be given in the shade and if possible in the shed which would precluded wild birds getting attracted to it and getting closer to the domestic birds. Any pools of water should be removed.

6. HEALTH MANAGEMENT

6.1. Standard Requirements/Ideal

In an ideal situation a vaccination regime is available for the layer and broiler flocks in each country and for the respective farms which is worked out depending upon the disease challenge in the country. Proper guidelines are given on how to dispose litter and the dead birds as well as where to obtain treatment for birds should they become sick.

Isolation of flocks from situations that expose them to disease is of paramount importance in disease prevention. All the farmer would be encouraged to learn what is required and observe the procedures correctly.

6.2. Actual/Current situation in Kenya

For the **commercial layer and broiler flocks** vaccines are currently available for all the common bacterial and viral diseases of chickens: e.g. Newcastle disease; Infectious bursal disease; Mareks's disease; Epidemic tremour; fowl pox; infectious laryngotracheatis; infectious bronchitis; egg drop syndrome-76; fowl typhoid (Bebora, 1998); mycoplasmosis. Turkey vaccines present are, for example: Newcastle disease; turkey pox; mycoplasmosis. The breeders are vaccinated as they are reared while Marek's disease vaccine is usually given at day old in the hatchery. All the other birds are vaccinated in the farmer's premises and it is the responsibility of the farmer to seek the assistance of the animal health professionals to get their birds vaccinated.

The **indigenous farmers** do not usually vaccinate their birds routinely unless there has been a concerted effort to introduce the vaccine in the area, for example, farmers in Kitui, Kakamega, Makueni have had at different times programmes that have encouraged vaccination of their flocks against Newcastle disease. Farmers in Makueni district farmers are being encouraged to keep chickens as a business and for this reason they have been taught the importance of forming farmers' associations and vaccinating against Newcastle disease. They have taken the matter very seriously for they have seen that where the birds have not been vaccinated they all died of Newcastle disease (Mary, 2007).

The dead **layer and broiler birds** are disposed of by burial in the farm or the dead birds are cooked and given to the dogs or pigs.

Treatment is carried out in **layer and broiler** flocks for bacterial and protozoan diseases and there are adequate supplies of the relevant drugs in the drug stores for the farmers to use. Most of the indigenous chicken farmers use traditional medicines to treat their birds and only a few can afford the modern medicines.

Isolation of flocks is a serious flaw in the bio-security status of **sectors 3 and 4** in Kenya since very little of it is observed. Layer and broiler farmers usually have their flock houses close to the dwelling houses and will frequently take their visitors to the flock houses to see and enjoy the flock. Furthermore, if they go to the market to sell eggs or to get feeds and they now want to go to the flock house, many do not change the shoes or the clothing that they went with to the market (Nyaga, 2007a,b).

Disposal of the manure and the slaughter wastes is done in the farm and the dead birds are buried in the farm as well by most farmers, while some may be sold to other farmers for cattle feed (Kanyongo, 1996; Murotho, 1981; Nambi, 1987; Nyakalo, 1991). Wild birds, wild mammals and the domestic pets also have access to the home compound and the outside of the flock houses. All these activities render separation of clean birds from the source of disease to be very difficult.

6.3. Recommendations

It is recommended that the **layer and broiler flocks** be vaccinated against common viral and bacterial diseases and they are sero-monitored regularly for sero-conversion to protective levels of antibodies. Treatment of common ailments be carried out but drug resistance by these agents to the commonly available antibiotics, particularly those which are also used for human treatment be monitored regularly to enable early identification of resistant bacteria that could transfer the resistance to human pathogens.

Since the farmers of indigenous birds are not using drugs for treatment, they could be encouraged to use the drugs should the farmers enter into farming as a business so that they reduce the losses that would come due to bacterial infections in their flocks.

In order to provide isolation of flocks, it is recommended as follows:

- That a program of educating farmers on the role and usefulness of isolation and other bio-security measure be developed and implemented.
- That the wastes from slaughtering process, the dead, the litter be disposed of in such a way that they do not introduce disease to the neighbour's flocks nor to any other flock in the home.
- That simple hedges be put in place to separate flock areas flock the areas where visitors have access.
- That dedicated clothing, which may not necessarily be new, are provided for use exclusively in the flock houses. This would go along with dedicated shoes and head wear that will be used in the flock houses only and not be for outside activities.
- That a disinfectant dip be provided at the entrance to the flock houses.
- That framers be taught to separate clean from dirty work, and that they do clean work first the follow with dirty work, for exam collecting eggs, feeding are clean works while disposing dead birds, removing caked litter from the flock house and cleaning dirty drinkers are all dirty works.

7. TRADE AND MARKETING

7.1. Standard Requirements/Ideal

The usual situation would be that a marketing organization does the marketing for the eggs and the meat and the farmers have a stable market through-out the year. It is expected that traders would join the organization and build a viable system across the whole country. In this way prices would stabilize and policies would be common all over the country.

7.2. Actual/Current situation in Kenya

In Kenya, there is no one trade organization as yet that drives trade and marketing for all the poultry and poultry products (Ndeda, 1980; Ngigi, 1988; Nyaga, 2007a,b). However, there is now an association for the poultry breeders and one for the poultry keepers but no umbrella one exists. In this regard layer farmers individually source for markets for their eggs while the broiler farmers do the same for markets for their broilers. Eggs are sold at the farm gate and then at the local markets and also to targeted restaurants and institutions where the farmers may have arranged contracts. In this regard bio-security risks arise in many stages of this cycle. At the local markets, the farmer is likely to come across infected materials. Furthermore, they usually bring back home the trays

they used to ferry the eggs with to the market. Their shoes also pick up infectious agents from the market as well, so do their clothes. Thus the trays, the shoes and clothes and the vehicle will take back to the home any infectious agents that was picked at the market.

Very few farmers will decontaminate the trays since they look clean unless there are egg breakages that smear the trays and these are treated as normal. However, should the eggs have been from a farm with an outbreak of Newcastle disease or avian influenza, the eggs would be carrying a lot of virus and the trays would be contaminated by the virus. Similarly any trays that would have come from an infected farm would have carried infectious material from the farm to the market. The ex-layers are usually sold to traders who take them to the urban markets for slaughter. The ex-layers are transported on top of buses and in modified open pick ups (Nyaga, 2007a,b). In either case, the birds are in direct contact with the atmosphere and wound be discharging any exudates into the environment along the path to the live bird markets. On the other hand, broilers are usually not sold as live birds but after slaughter. If the farmer has made arrangements to supply to specific hotels and restaurants or institutions the broiler meat is kept frozen until they are able to supply the orders as required(Nyaga, 2007a,b).

Bio-security concerns during slaughtering would be where and how the waste water, feathers and offals, which may lead to spreading of disease, are disposed. There transport vehicles could be one source of bio-security breach and it is not clean whether they are decontaminated between the markets and the home slaughtering activities. The traders themselves act as sources of infectious agents.

Farmers keeping indigenous birds do not have many eggs to sell but when they do sell they sell them at the farm gate or at the local market. The only bio-security risk here is the farmer getting the feet or clothes contaminated at the market. However, the birds are sold live and the local market where the primary collectors assemble them for further transit to the municipal and city open air live whole and retail markets (Mary, 2007). Slaughtering occurs at any of these points of sale. Once the birds are killed, the feathers are removed by either dry or wet defeathering. Wet defeathering is done at the municipal slaughter houses and at the satellite “chicken and egg” kiosks to be found in most of the housing estates in the city of Nairobi (Nyaga, 2007).

The bio-security risks at the slaughtering process are many. The dry defeathering scatters feathers all over the sales areas at the local markets. However, one commercial indigenous chicken slaughter house used dry defeathering and effectively managed to contain all the feathers within the building and later burned them (Nyaga, 2007b;). This was a very good way to contain possible disease spread. They also cleaned the slaughter house very thoroughly to the extent that if one visited the premises two hours after the cleaning one would think no work ever goes

on there. However, all the other places where there is dry defeathering it would be easy to spread disease since they did not observe adequate hygiene measures.

For wet defeathering, the disposal of waste water, the offals, the feathers and the presence of worn out cement floors, the presence of bird cages and storage of personal effects in the cages that also held chickens posed a big bio-security risk (Nyaga, 2007b).

7.3. Recommendations

Farmers need to be made aware of the possible bio-security risks and flaws that they get into during the marketing of their poultry products and be shown what to avoid and how they can improve their practices so that chances of bring in disease to their flocks are b reduced and the possibility of spreading disease to their neighbours is reduced This would include:

- Observing regular washing of hands.
- Personal hygiene and use of clean or dedicated clothes and shoes.
- Identifying clean and dirty processes in the farm, sales and slaughtering processes so as to avoid contaminating clean areas.
- Use of disinfectants to decontaminate materials and equipment that has gone to the market before it is re used at the farm.
- Refraining from returning to the flock house any birds that left the home for the show or for sale but were not sold out.

The municipal authorities need to work out procedures that ensure that the premises are kept clean and decontaminated before and after the slaughtering process. This would also involve creating awareness of the bio-security flaws that are prevalent at each stage of the slaughtering process. They should be congratulated for the things that they have done well.

8. ANIMAL-HUMAN HPAI: TRANSMISSION

8.1. Standard Requirements/Ideal

Animal to human transmission of avian influenza is currently believed to occur when there is very close contact between the person and infected poultry source. In this regard, the persons at risk would be individuals at the live bird markets, slaughter houses, poultry houses and any other such circumstances in which an individual spend quite some time in close proximity to infected birds.

8.2. Actual/Current situation in Kenya

Currently Kenya is free of avian influenza (Kimani, etal.2006; Nyaga, 2007a,b). However, were it to occur, the following persons would be at risk of exposure to avian influenza H5N1 HPAI and subsequent infection, namely:

- Poultry-men and women who spend at least two to three continuous hours in the poultry house giving food and water or maneuvering the litter.
- Any persons traveling in the same vehicle that might be carrying infected birds in side the vehicle or in any of its carriage compartments.
- Buyers and sellers of live birds, especially when the premises are enclosed and there is accumulation of aerosols in an enclosed environment.
- Workers in the chicken abattoirs whether they use dry or wet defeathering methods.
- Persons who may sleep in the same house with an infected chicken.
- Persons working full time in a chicken meat processing plant and handling raw chickens for a prolonged period of time.
- Any person who may be at a dry de-feathering slaughtering process and is reached by the aerosols generated from the sick birds being slaughtered.
- Any persons who may dispose slaughter waste, offals or litter from infected premises.
- Any person who may consume raw infected chicken offals, meats or undercooked chicken meat on infected raw eggs and or products made from raw infected eggs.

8.3. Recommendations

It is recommended that:

- Any person who is in any of the situations listed in section 7.2 above be considered to have been exposed to avian influenza and be closely monitored.
- That any of the circumstances listed in section 7.2 above be areas to put preventive control measure.
- That other novel means of transmission may arise since the disease is still evolving and it may involve other species not yet identified and therefore other ways in which the disease may be transmitted may be looked. Beyond the traditional ones we are familiar with.

9. CONSUMER PROTECTION

9.1. Standard Requirements/Ideal

When one thinks of only consuming poultry products, what comes to mind is the consumption of eggs and the traditional cuts of the chicken meat. However, it is necessary to think of other parts of the chicken that may find their way into the informal markets but still pose danger of transmitting disease to those who may get in contact with them

9.2. Actual/Current situation in Kenya

A large proportion of poultry meat consumed and coming from sectors 3 and 4 is inspected but some small proportion may not be inspected. The farmers living near the city of Nairobi and other urban centers would usually call in a meat inspector when they slaughter their broilers who then inspects the meat and issues a permit for the meat to be transported to the market. All the municipal slaughter houses where indigenous birds are sold and slaughtered have a meat inspector whenever they slaughter poultry (Nyaga, 2007b). Most of the ex-layers that find their way into the city of Nairobi are all slaughtered under inspection at Kariokor and Burma markets and if slaughtered at home the meat inspector is called into inspect the meat (Nyaga, 2007b). However, there may be some indigenous sector 4 and other sector 3 birds that might skip this route and are therefore not inspected.

Regarding eggs, there is no formal inspection carried out that the author is aware of except that done for grading the eggs into: small, medium and large (Njenga, 2005; Ndeda, 1980; Ngigi, 1988) and to remove those that are badly soiled and are therefore not fit for the market. It would be difficult to identify any eggs emanating from an infected flock and any infections are likely to pass on to the consumer unless the eggs are cultured.

9.3. Recommendations

On the whole most chicken meat consumed is inspected and the small proportion that does not get inspected may need to be identified and be brought into the inspection loop.

A way to identify eggs that may have been from avian influenza infected flock needs to be developed to safeguard the human population against infection from infected eggs.

10. ECOLOGY: WILD BIRDS, FLYWAYS, WETLANDS

10.1. Standard Requirements/Ideal

It is believed that wild migratory birds, especially waterfowls and shore birds are the major reservoirs of avian influenza in the wild and they are likely to introduce the avian influenza virus into a new territory. Mallard ducks, teals, geese gulls and swans have been implicated in the introduction of the virus to new areas in some of the confirmed cases of avian influenza H5N1 outbreaks. In the wild birds the avian influenza does not produce severe disease; there are also other low pathogenic avian viruses which can be found in healthy looking wild birds. Currently, it is believed that the severe disease with high mortality occurs in susceptible infected birds where highly pathogenic strains of H5 and H7 subtypes have arisen from low pathogenic strains through mutations (Benedictis etal 2007; Garcia, 1996). Such mutations appear to occur when the viruses move from the wild birds to poultry (Benedictis etal, 2007). Thus, any country that is in the migratory flyway of the migratory birds is at great risk of getting the virus introduced into the wild bird population and subsequently get the poultry population infected.

10.2. Actual/Current situation in Kenya

Wetlands are home to many resident waterfowls and other birds in Kenya. Migratory birds come into the country from the month of October and go away by the months of March –April the following year. During this period the resident and the migratory birds have a chance to mingle together in the wetlands. There are many waterfowl in the Kenya wetlands. However, results of wild bird surveillance studies have so far not indicated the presence of H5N1 HPAI (Kimani et al, 2006; Nyaga, 2007a,b).

There is evidence of domestic birds mixing with wild birds although some of the birds may not be the waterfowl that are supposed to be the carriers of the avian influenza virus. Nonetheless these birds could also carry the virus and introduce it into Kenya. Kenya lies along the Mediterranean flyway to South Africa and is therefore at high risk of getting avian influenza introduced via the migratory birds.

10.3. Recommendation

It is recommended that studies be done to establish exactly which migratory birds do mingle with the Kenyan wild birds and which of these wild birds have access to home or to scavenging birds with which they can mix and bring the avian influenza virus into the domestic stock.

It is recommended that, if possible domestic bird flocks should not be established near water ways to avoid the potential of mixing with the wild birds.

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12. 0 ANNEXES

ANNEX 1.0

POULTRY SECTORS : SHORT DESCRIPTIONS OF EACH OF THE FOUR SECTORS AS IDENTIFIED BY FAO

Sector 1: Large scale commercial system {Raise Commercial Grand parents and parent stock (Breeder farms) and manufacture poultry feeds}. Size per enterprise can be more than 500,000. Size may however vary depending on the country, industrialized or developing country. In developing countries are usually much less than 500,000. Management standards and biosecurity are very high. Intensive system (housed and indoors) and no contact with other domestic or wild animals. May use own commercial feeds. Will have own veterinarian and animal husbandry experts. Source of technical information is from the company and associates. Farm outputs are processed and/or packed for export and for urban markets. Highly dependent on market for inputs, including medicines and vaccines and dependent on good roads. Usually located near capital and major cities. Owners are wealthy.

Sector 2: Medium scale commercial production system (Raise commercial poultry – layers and/or broilers and may be parent stock as well or only parent stock or commercial poultry). Flock size varies from more than 500,000 in industrialized countries to much less e.g. 5,000 as is the case in Indonesia or even 100 to 2,000 like in Vietnam. Management standards and bio-security levels are moderate to high. Intensive system of husbandry and hence kept indoors and hence no contact with other domestic and wild animals. Market outs are processed and /or packed for urban and in some cases rural markets. Dependent on market for inputs including medicines and vaccines and depend on good roads. Source of technical information is from sellers of inputs and/or veterinarian. Usually located near capital and major cities. Use commercial feeds. Have own animal husbandry expert and use and pays for veterinary services or have own veterinarian. Owners are wealthy.

Sector 3: Small scale commercial production system (Raise commercial poultry only – layers and/or broilers). Resembles Sector 2 but management standards and bio-security levels are low. Under intensive husbandry system or may have a run. Dependent on market for inputs and dependent on good roads. Contact with other domestic and wild animals does occur. Use commercial feeds. Usually found in the developing countries and owners have relatively moderate capital. Flock sizes vary from 50 in Vietnam to up to 10,000 in Indonesia. Farms are located in urban, peri-urban and also in rural areas. Market outputs are in form of live birds and sold in urban or even rural areas. Use and pay for veterinary services regularly. Source of medicines and vaccines is the market. Technical information is from sellers of inputs or veterinarian. Owners are of middle income and enterprise may the major source of income and/or supplement income from other sources, usually salaries.

Sector 3 may be divided further into two (A and B). Thus:

Sector 3A: Small scale commercial production system consisting of either chicken layers or broilers, ducks, turkeys, geese or quails.

Sector 3B: This refers to Organic farming systems. It is an integrated production system with free ranging animals in large outdoor runs.

Sector 4: Small scale Village or backyard system. Practice free unselected breeding, flocks are multi age and mixed species (other birds or small ruminants and pigs). Flock sizes are small averaging 10 indigenous birds per flock. Management standards and bio-security levels are usually poor. It is an extensive system with no or little restriction of movement and birds are out most of the day but normally kept inside at night. Birds come in contact with other domestic and wild animals all the time. Market outputs are for rural as well as urban markets. There no or low dependence on markets for inputs or on good roads. Are located in many types of places but mainly in rural areas, but also in peri-urban and urban areas. Usually do not use animal husbandry and veterinary services. May use Government veterinary and other extension services if available. Predominantly found in rural

areas. Are free ranging with little supplementary feeding. In some rare cases, e.g. Egypt, may be confined and fed commercial feeds. Are managed and in many cases owned by women and children. The income of such households is normally low and food security varies from adequate to poor.

Sector 4 may be divided further into two, thus:

Sector 4 A: Is a mixed farming system and includes crop production. Raise indigenous local birds for meat production usually and not for eggs.

Sector 4B: Raise improved breeds or crosses. Have more improved management. Use animal husbandry and veterinary services on a regular or irregular basis and may vaccinate and treat their flocks. This is the case in the backyard poultry practices in Egypt.