Food and Agriculture Organization of The United Nations

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

Poultry Sector Analysis:

Bio-security Review and Improved Poultry Husbandry Systems

for Sectors 3 and 4 to Prevent HPAI Infection in Uganda.

Pigeons on maize intended for chicken feeds. Dedicated wear and cleaning of equipment

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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, Nigeria first reported outbreaks in February 2006; followed by Egypt in the same month and year. Eleven countries in Africa have so far reported outbreaks of HPAI. These are Sudan, Djibouti (Eastern Africa), Nigeria, Togo, Benin, Ghana, Cote d'Ivoire, Niger, Burkina Faso, Cameroon (Western Africa) and Egypt (Northern Africa). These outbreaks have lead to devastating economic and socio-cultural consequences. The risk of avian influenza H5N1 spreading to other Africa countries is very real.

Once a H5N1 avian influenza outbreak occurs in the poultry population of a country, it threatens human health, destabilizes the poultry industry and decimates the national poultry biodiversity. The livelihoods and socio-economic activities of vulnerable groups are greatly endangered.

Although farmers in sectors 1 and 2 have capacity to carry out bio-security measures, they would incur the heaviest losses in the event of an outbreak. On the other hand, sectors 3 and 4 farmers, who are less able to practice biosecurity are most likely to experience difficulties and vulnerabilities in the event of an outbreak of avian influenza notwithstanding that it is here where control measures are most difficult to implement. Lessons from outbreaks that have occurred in African countries show index cases detected in commercial poultry farms confirming that any production sector is vulnerable. Therefore, a study of the strengths and weaknesses of the bio-security status covering the full value chain in all poultry sectors and with special emphasis in sectors 3 and 4 is essential. This will lead to the development of effective disease control strategies and measures that encourage sustainable safe poultry production.

A study of this nature would provide a good understanding of the relevant practices by poultry farmers, traders and service providers. It would identify possible bio-security flaws; the potential routes through which birds may acquire avian influenza infections; the possible human exposure risk areas; and the likely vulnerabilities in the livelihoods of poultry farmers and those in the poultry industry. Alternative interventions would them be identified for implementation by the animal health and other relevant professionals of the country. The study would also help the country to develop appropriate legislations and seek funding for the control measures necessary to implement improved bio-security systems.

This report therefore describes a review of the bio-security and husbandry practices and systems for all poultry sectors in Uganda with special emphasis for sectors 3 and 4 with a view to the prevention of HPAI infection. It is part of a series of Country Reports that are commissioned by the Animal Production Service (AGAP) of the Food and Agriculture Organization of the United Nations (FAO) for the Socio-Economics and Policy Working Group of 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, AGAP and the Socio-Economics and Policy Working Group.

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ACRONYMS AND ABBREVIATIONS

AGAP	Animal Production Service of the Food and Agriculture Organisation of the United Nations (FAO)
AI	Avian influenza
DOCs	Day old chicks
ECTAD	Emergency Center for Transboundary Animal Diseases
FAO	Food and Agriculture Organisation of the United Nations.
FAO-REP	FAO Representative
HPAI	Highly Pathogenic Avian Influenza.
HPAI H5N1	Highly Pathogenic avian influenza of hemagglutinin subtype 5 and Neuraminidase subtype 1
ILRI	International Livestock Research Institute
LPAI	Low Pathogenic Avian Influenza.
MAAIF	Ministry of Agriculture, Animal Industry and Fisheries of the Republic of Uganda
NAADS	The National Agricultural Advisory Services.
ND	Newcastle Disease
NGO	Non-Governmental Organisation
NUSAF	Northern Uganda Social Action Fund
OIE	Office Internationale des Epizooties
PAU	Poultry Association of Uganda
SOPs	Standard Operating Procedures
ULCFA	Uganda Local Chicken Farmers' Association
USAID	United States of America Agency for International Development

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EXECUTIVE SUMMARY

Although Uganda has many wetlands and lies 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 extremely high given the fact that outbreaks have occurred and continue to occur in Egypt which lies directly along this flyway. It is therefore appropriate to assess the possible bio-security flaws that may arise in all the poultry sectors placing special emphasis on the more vulnerable poultry production systems of sectors 3 and 4. In this regard FAO has commissioned a biosecurity study of all the poultry production sectors in Uganda to identify the potential bio-security risks in order to lay a basis for developing effective control measures and provide guidelines for appropriate bio-security interventions.

Bio-security principles are to be incorporated at the ***conceptual*** stage of each component of the poultry value chain and then during the actual implementation of the ***structures to carry out the business***. Once these are in place, **operational** biosecurity principles are designed for the day to day simple procedures and practices which when applied prevent entry into or spread within a farm of disease agents, or the exit of the disease agent from infected premises.

The operational protocols are summed up into three principles, namely: **Isolation** which involves procedures, practices, and manouvres to ensure that clean flocks remain free from disease agents and that disease agents remain confined in infected flocks and do not spread to other premises; **Traffic control** which includes signage to warn visitors that biosecurity protocols are being observed; controlling movement of stock, persons, goods, equipment and products into the clean farm and out of infected premises; and finally **Sanitation,** which involves methods that enable farmers to maintain farm houses, vehicles, implements and equipment, remain in a state of sustained cleanliness, and are disinfected.

Thus, the flaws and strengths in any of these biosecurity issues were investigated throughout the poultry value chain in Uganda. The exposure to biosecurity risks was found to differ for the respective poultry sectors, as follows:

SOURCE STOCK

Commercial broiler and layer hatcheries

These operations have been classified as sectors 1 and 2 in a past study. They have well established infrastructure and biosecurity systems including secure fencing with controlled gates; separate farms for breeder and grower flocks; well constructed and appropriate flock houses; use of colour coded uniforms for different farm houses and different services; egg trays similarly color coded, and decontamination control points. The major risks where seen were:

- Relaxation in following the established biosecurity protocols, e.g. the gates were left open for too long; skipping boot dipping at the gates; delivery vehicles drove far into the compound without decontamination.
- Local poultry found scavenging along the fence next to the feed mill.
- Feed mill covered by dust and doors kept wide open
- Feed raw materials store located next to flock houses.
- Feed mill and workshop next to the hatchery wash area
- Office for customers located far inside and very close to entry to flock houses.

- Disposal of chicken blood to pig farmers may compromise disease prevention.
- DOCs chick boxes carried on motorcycles and shop verandas.

The last three issues are conceptual and structural biosecurity matters that cannot be changed without high costs and disruption to the operations. Currently, it is easy to obtain broiler and layer day old chicks directly from the hatcheries or their distribution agents.

Recommendations:

- Enhance auditing and implantation of established biosecurity standards
- Develop standard Operating Procedures where this is not already done
- Reduce dusty sites and clatter in the premises.
- Provide lunch for feed mill workers so they do not have to go to places where they may encounter chicken and wild bird feces.
- Chick boxes containing DOCs be kept inside clean premises.

Hatcheries for local chickens

The hatchery for network of farmers under the ULCFA had challenges on uniforms, waste disposal and cleanliness of facilities. The egg store combined also for collection of day old chicks and orders for growers. Lack of separation for the different activities compromised disease control options. Day old chick boxes were purchased from vendors external to the network and their hygiene was not assured while the solid wastes were disposed on the premises grounds. The locally made incubator was made of materials that are difficult to wash and decontaminate and was also used to brood and grow the birds until they were sold off. This meant that the incubator could not on its own be kept free of disease agents. The eggs were also obtained from different farmers posing other biosecurity challenges.

Recommendations

- The hatchery building windows should be regularly cleaned to reduce dust going into the hatchery and openings at the back of the hatchery building be sealed with bird proof netting.
- Find alternative ways to safely dispose hatchery solid wastes.
- Use new decontaminated chick boxes at the hatchery before loading DOCs.
- Keep the egg store clean and free of other equipment not used for handling eggs.
- Orders for growers should not be handled at the same office as DOCs and eggs.
- For the locally made incubator, establish a brooding and growing place separate from the hatching process. The incubator can then be dismantled and decontaminated ready for immediate use.
- Decontaminate eggs before setting them in the incubator.
- Isolate the hatchery from other traffic.

Village local chickens

Farmers keeping indigenous chickens source their original breeding stock from a neighbour, the live bird markets or the local chicken hatcheries and growers. They must be encouraged to use a clean disease free source.

HOUSING

While some of the houses in sector 3 and 4 are made of washable brick walls and concrete floors, many of the traditional houses in sector 4 are made of mud or wooden plank walls and grass; all of which are difficult to clean and decontaminate.

The broiler and layer chicken houses were made of brick walls, wire meshing and iron sheet roofs or thatched roofs. One farmer had slated floor for broilers and layers in two separate houses made of brick walls, concrete floor and iron sheet roof and they were doing very well. The housing for the largest layer keeper had earth floors, brick walls and iron roofs, but since the houses had a very big width span, it was necessary to have many large wooden poles supporting the two floors. This would make cleaning and decontamination hard to do.

Recommendations

Where chicken house walls are made of bricks, the walls are to be plastered and mud walls be covered with cement screed to make cleaning and decontamination easier. The wooden planks are to be painted with water resistant paint which will seal the cracks in the planks so parasites do not hide there and to facilitate washing and disinfection. There is nothing much one can say about modifying the grass thatched roofs nor those made of bamboo. However, where the house walls are plastered, the bamboo roof can be washed and disinfected. The houses should be spacious, have good ventilation but reduce wind chill and allow the poultry worker free access to the birds. Laying boxes should be provided.

HUSBANDRY

Commercial hatcheries had very good husbandry systems in place for the production flocks, breeding farms and the hatcheries. They may need to carry out regular audits to ascertain that the systems are still in operation effectively. Their day old chicks are distributed throughout the country posing enormous challenges to biosecurity.

Commercial layer and broiler farmers practiced very good brooding and growing of birds. Biosecurity issues arose in the disposal of dead birds, manure, feathers and offals from slaughter of chickens which are done on the farms; and the exchange of egg trays during egg marketing. Wild birds could get access to raw materials and final feeds when mixing was done at home exposing the chicken to introduction of avian influenza. Keeping of other species of birds, e.g. guinea fowls, turkeys, geese in the same compound with the commercial layers was observed. However, one broiler farmer who had 500 birds every two weeks and also kept commercial layers observed good husbandry practices. The brooders were clean, birds were well spaced and some on slatted floors and drinkers and feeder scrupulously kept clean. The only flaw was lack of a perimeter fence.

The indigenous chicken farmers' networks pool eggs for hatching and later carry out re-distribution of day old chicks and growers. This practice created dangerous biosecurity risks. In the event of an avian influenza outbreak in any part of the network, the disease would spread very quickly in the country.

Recommendations

- Commercial hatcheries regularly audit their husbandry practices to ensure adherence to standard biosecurity protocols.
- Training in good husbandry practices be done for commercial and indigenous poultry farmers to include: proper feed types and timing of feeding and picking eggs; use of clean feeders and watering equipment; removal and disposal of dead birds and the cleaning and disinfection of houses and coops; use of clean foot wear and clothing and the control of movements; and the keeping and use of good records

- Removal of attractants that could draw wild birds to the farm, e.g. spilled feeds or wet litter; open water spots; trees with thin branches that may be suitable for bird nests; disposal of slaughter wastes.
- Egg trays not to be exchanged with those of buyers; change from paper to plastic trays.

FEEDS AND FEEDING

Commercial hatcheries have access to technical information on the composition and use of rations for the different ages of birds. Many farmers of commercial layers and broilers purchased ready made feeds from feed shops while some mixed their own feeds at home or bought from small scale feed mill facilities nearby. Biosecurity risks would arise during the preparations in both cases should wild bird fecal matter contaminated the raw ingredients. While farmers with 50 or more indigenous chickens mixed their feeds at home, the majority of farmers leave the birds to scavenge for their own food in the banana plantations or the home environment. The latter were more likely to contact wild birds or their droppings thereby getting sick from disease agents brought about by wild birds or animals.

Recommendations

- Feed for commercial layers and broilers should provide a well balanced diet with all the nutrients required for growth and production and be protected so it is not contaminated with wild bird droppings. Feeders should be cleaned and decontaminated regularly and wild birds should not have access to the feed in the troughs through holes in the wire netting.
- Water and supplementary feeding for scavenging chickens be offered in the shade and preferably inside the shed to avoid attracting wild birds.
- Feed ingredients not to be exposed to contamination from wild bird droppings

HEALTH MANAGEMENT

Commercial hatcheries have well established vaccination and treatment regimes while vaccines against the common poultry diseases are available for the commercial layer and broiler flocks and indigenous birds kept indoors. Most scavenging indigenous chickens are usually not vaccinated except where specifically introduced.

Recommendations

- Training programme be developed to educated farmers on the benefits they can get from healthy poultry through use of biosecurity measures.
- Make simple hedges around poultry houses to separate flocks from visitors.
- Use dedicated clothing, footwear and head gear that may not be necessarily new while working in chicken houses.
- Routine vaccinations be carried out.

TRADE AND MARKETING

There is not a single umbrella organization driving trade and marketing for the poultry industry in Uganda. Hatcheries import day old breeding stock and subsequently sell commercial day old chicks. Commercial layer farmers purchased their day old chick and sold out eggs and off-layers to intermediaries who then transport them to town markets in cages carried on motorcycles or on taxi carriers. The egg trays were exchanged at the markets. Live indigenous birds were transported in plastic, wooden

open cages or cartons on bicycles. Live indigenous birds were sold at roadsides in the open or if at the live bird markets they were kept in cages made of wood, metal wire only or lined with plastic papers or wood planks. Only in two markets was there a regime to clean the cages while in others the droppings accumulated and caked in the cages. The cages were clustered together in the open or placed inside a shed. Birds were slaughter in makeshift open places with minimal facilities and wet or dry plucked. These live bird markets were located conveniently at road junctions in residential areas or corners in shopping centers or municipal markets. No personal hygiene measures like washing hands before or after handling birds was practiced.

Recommendations

- Cages be washed with detergent and be decontaminated daily
- A once a week rest day be introduced for thorough cleaning and disinfection.
- Basic personal hygiene be practiced by all who handle poultry
- Formal slaughtering places be introduced together with meat inspection.
- Paint all cages, irrespective of materials making them with water resistant paint and whether they are used to carry chickens or to keep birds at the live bird markets. This will facilitate easy cleaning.
- Cages should not be stacked. Where this is done, solid painted wooden boards be used to cover cage bottoms to prevent soiling of birds at the lower cages.
- Committees be established where this is not the case and they be trained in biosecurity principles. A routine be established to implement biosecurity at the markets.
- All persons associated with the trade, right from primary collectors at local village markets, transporters, live bird traders, local authority inspectors, traders and slaughtering personnel, must be involved in developing biosecurity measures that will harmonize with their business activities at the same time preventing disease spread.

ANIMAL-HUMAN HPAI TRANSMISSION

Persons constantly exposed to high concentrations of poultry dust and aerosol, for example those in live bird markets, slaughter houses, poultry houses and poultry transporter, especially *boda boda* and bicycle options; and persons involved in handling wet poultry, e.g. roadside “chicken *muchomo*” (roast chicken) poultry processors were identified as being at high risk of contracting avian influenza disease.

Recommendations

- Training in biosecurity principles be done.
- Simple procedure like washing hands and personal hygiene; use of clean flocks as source of original breeding or commercial stocks; daily washing and decontamination of live bird market cages and carry crates; not exchanging one’s own egg trays at the markets will reduce chances of spreading avian influenza and reduce possibilities of both flocks and humans getting infected and are recommended to be implemented.

CONSUMER PROTECTION

Most poultry was slaughtered in places where inspection as to fitness for human consumption was assured except at the commercial slaughter houses. Chicken grilled on roadside centers and sold to travelers may be exposed to airborne pathogens. If not well cooked and assuming the birds were infected with H5N1, these poultry products might be a source of human infection, notwithstanding the fact that those involved in slaughtering would be first be in line to be exposed to H5N1 infection.

ECOLOGY: WILD BIRDS, FLYWAYS, WETLANDS

The many wetlands and waterways are landing sites for migratory birds. There are scavenging chickens, commercial layer and broiler flocks located in close proximity to almost all these areas. Birds that were shown to be positive for H5N1 in Hong Kong in the outbreak years of 2006-2008 like little egret, great egret, pelegrine falcon, grey heron common kestrel and many others and also the house crows, are present in Uganda. Farmers keep geese and ducks in home ponds in places where migratory ducks are also present, e.g. in Rakai and Kiruhura. These issues agree with the HPAI risk maps drawn by the ILRI teams and present a very high risk to HPAI transmission. However there is a cattle belt running across the country from south west to the north east that, in my opinion may act as a *trough* cutting off transmission of HPAI from west and north to the south where poultry densities are high since chicken are absent or in very low numbers in this cattle belt. Dropping of migratory birds would also be lost in these grasslands.

Recommendations

- Great vigilance be exercised to monitor any deaths of either wild or domestic birds anywhere near the wetlands
- Surveillance for Newcastle disease antibodies in non vaccinated scavenging chicken can be used to monitor possible infection with HPAI should it occur.
- Flocks that are established close to the landing sites be monitored for avian influenza
- Some wild birds shown to have been infected with H5N1 in Hong Kong outbreaks of 2006-2008 as well as those recorded positive in other countries are found in Uganda. This poses potential risk to HPAI introduction and spread. Targeted sampling and monitoring of these birds would greatly assist in HPAI risk assessment.

LEGAL ISSUES

Legal provisions are there in the Animal Diseases Act, the Public Health Act and other legislations that would enable the control of avian influenza as an epidemic. However, some issues are not provided for. Therefore Statutory Instruments be developed to provide for:

- Legislations regarding the establishment, running and inspection of hatcheries, poultry slaughter houses and live bird markets.
- Legislations to regulate the transportation of live poultry; trade in live bird markets, and the disposal of dead poultry and slaughter wastes at live bird markets
- Legislation to provide for HPAI, LPAI and other poultry notifiable diseases
- Legislation to provided for inspection and certification of slaughtered poultry.
- Legislation to declare Ostriches as poultry for purposes of avian influenza disease control.
- Legislation to establish poultry feed standards and to regulate operations of feed mills be to reduce introduction of avian influenza through contaminated feed.

1.0 INTRODUCTION

1.1. General background

Much of the Uganda land mass covers a wide range of topographical and climatic zones from the tropical rain forests, temperate highland areas; grasslands, to arid and semi-arid areas, the latter being in the North and Eastern parts of Uganda; and finally the extensive riverine and wetland ecosystems of lakes and marshlands. Uganda has a large share of the largest fresh water mass in Africa, Lake Victoria which has a number bays and islands offering preferred sanctuary for resident and migratory birds. Both resident and migratory birds may mix with domestic birds with potential to introduce avian influenza into the domestic flocks. Currently, Uganda is free from highly pathogenic avian influenza (HPAI) H5N1. Uganda is traversed by two North-South migratory bird flyways, namely: Black Sea /Mediterranean; and East Africa – West Africa posing a serious threat and great danger of HPAI introduction.

Subsequently, and considering the global spread of highly pathogenic avian influenza and its introduction to African countries, there is every reason to be concerned with how preventive measures can be effectively applied in all sectors of the poultry industry in Uganda. Despite Uganda not having had any incursion of HPAI, an avian influenza scare in the 2006/2007 period had a very adverse impact on the poultry industry and all the associated industries and all persons whose livelihoods relied on poultry.

Identification of any flaws in bio-security in any section of the production systems would be critically important. This would allow the government agencies to develop and carry out targeted interventions to prevent entry of HPAI or to quickly contain an outbreak in the event the virus enters the country. Thus, there is a concerted effort by the Government of Uganda 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. The later have since been classified into sector 3 and 4, respectively in a recent FAO commissioned poultry sector analysis study report. In this regard, the FAO has initiated efforts to gather all available information that is relevant to bio-security in the operations of all poultry sectors in Uganda.

Therefore a study was commissioned entitled, "**Poultry sector analysis: Bio-security review and improved poultry husbandry systems with special reference for Sectors 3 and 4 to prevent HPAI infection in Uganda**" The information obtained will be used to develop strategies and guidelines for safe poultry husbandry and improved bio-security practices for the poultry industry in Uganda and thus prepare to prevent incursion by HPAI and outbreaks of other poultry diseases.

1.2 Definition of bio-security

In order to have a common understanding on the issues at hand when dealing with issues of bio-security in the different poultry production systems and also when dealing with the human 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 a farm or between farms.

In Uganda viral, bacterial, fungal and parasitic infectious diseases affect poultry in each of the sectors. The major viral diseases in order of importance are: Newcastle disease; infectious bursal disease; fowl pox; Marek's disease; avian leucosis and epidemic tremour; while the bacterial diseases are fowl typhoid, colibacillosis, salmonellosis; infectious corrhyza and mycoplasmosis which are common in all sectors. Coccidiosis is very common in sectors 2 and 3 and to some extent in sector 4 and parasitic infections affect all poultry. 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. Effective biosecurity measures would not only reduce chances of entry and lead to quick detection and elimination of HPAI but reduce prevalence of these other diseases named above. This would lead to improved poultry productivity, enhanced livelihoods and safe poultry products and food security. The disease agents are transmitted to flocks through entry of sick birds, contact of clean birds with inanimate materials like feeds, water, feeders, waterers, dust, farming equipments, vehicles, workers' clothes, head gear and foot wear that are contaminated with infectious agents or from infected wild birds.

To preclude the occurrence or the spread of such diseases through operations in the poultry value chain, the thinking, planning and design of facilities in each segment would take cognizance of biosecurity protocols and incorporate these in the structure or facility at the very beginning. Therefore, there are three stages or opportunities to consider biosecurity in poultry operations.

Conceptual biosecurity is the consideration and incooporation of biosecurity protocols and issues in everything done whenever one gets involved at any component in the poultry value chain. It is in the business plan and included in:

Breeding farms:- Poultry acquisition and delivery, brooding, growing to point of lay, egg collection and hatching.

Broiler farms:- Poultry acquisition and delivery, brooding, growing to finishing and processing meat birds;

Commercial layers:- Poultry acquisition and delivery, brooding, growing to point of lay, egg collection, packaging and transportation of eggs to the market for layers flocks. It determines the location of the farm (for example a breeding farm is not located near a road or a poultry or pig slaughter house), geographic separation, location of the buildings, the type and use of buildings, the location of the feed mill, the hatchery and the reception for visitors and customers.

Trade in live birds:- It determines the location of the shelter for bird cages and the slaughter houses in the municipal markets.

Once these activities are carried out, the ensuing products are fixed on the ground and if they stand in the way of or a biosecurity protocol was omitted or overlooked, they cannot be changed in the event of a disease outbreak.

Structural biosecurity is how we set up the business concepts developed above. It determines the layout of the farm, location of the roads and ditches, construction, entry ways or biosecurity buildings; and the location of the live bird market stall. Similar to the above biosecurity scenario, if any of these measures abrogated a biosecurity

protocol, they are not changeable in the short run in the event a disease outbreak occurs and one has to find the best way to mange the biosecurity flaw. However, the activities we do daily constitute systems for which application of biosecurity protocols can alter the course of disease if implemented. This is where ***operational principles of biosecurity*** apply.

Operational biosecurity therefore includes fundamental principles that apply to what we do day-to-day to keep operations free of disease agents and to prevent spread of disease from infected premised. It includes the role of employees in keeping diseases out; policies, procedures and practices for people, supplies and equipment entry; everyday practices that affect flock health and performance; monitoring flock health status and immunity and continuous review by all employees of all constituted biosecurity operations.

These activities are summed up into three **operational biosecurity principles,** 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 and personnel behaviour within the operation.
- **Sanitation which** refers to the **cleaning** and **disinfection** of equipment, housing, protective clothing for poultry workers, and sustained personal hygiene that will lead to destruction of disease agents. The latter 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. Additional measures here also include 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 each of the four poultry sectors and the complete poultry production value chain will therefore involve evaluating the inclusion or omission of

measures directed at ensuring that these principles are fulfilled in the poultry operations assessed.

1.3. Methodology

In order to obtain the necessary information, the International Consultant accompanied by the Avian Influenza Project coordinator visited two major commercial breeding farms and their hatcheries; a commercial slaughter house; a feed mill; varying sizes of commercial broiler and layer flocks; indigenous bird farmers, contract hatching /brooder/grower facility for indigenous birds using locally made incubator, live bird markets and associated local slaughter facilities, and chicken associations dealing with the slaughter of broilers for grilling and countrywide local chicken hatching and distribution. To achieve the above tasks visits were made around Kampala and its environs, Jinja, Iganga, Tororo, Soroti and Lira, Nakasongola and Luwero in the Eastern, Northern and central parts of Uganda. Subsequently the Western areas of Fort Portal, Kamwenge and Kasese were visited. The border points with Kenya and Democratic Republic of Congo (DRC) were also visited, while data for the border with Sudan was obtained from traders and officials in Lira, Kamudini, and Karuma markets. The Uganda Local Chicken Association Facilities including their hatchery and later the Lutembe Beach on Lake Victoria were visited. Visits were also made to the relevant Government officials. During these visits interviews were done, directly in English by the consultant where possible and by a checklist through the accompanying coordinator in the local languages that were transcribed immediately enabling the consultant to seek clarification of points that were not immediately clear.

Documents on country poultry review, legislations, marketing, biodiversity, poultry diseases and any others relevant to the consultation were reviewed. All information was then collated into the report herein.

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 Uganda or import day old chicks from sources that are approved by the veterinary authorities in the Ministry of Agriculture, Animal Industry and Fisheries (MAAIF) of the Republic of Uganda. This is regulated to prevent importation of infected chicks. However, the indigenous farmers are expected to individually make their own arrangements to source their starting stock from whatever internal sources they may determine. These are personal choices which would be difficult to regulate but where suitable advice would be helpful.

2.2 Actual/Current situation in Uganda

2.2.1 Commercial exotic bird hatcheries

The **commercial layer and broiler** day old chicks are obtained from the four main hatcheries in Uganda, namely: Ugachick, Biyizinka, Bokomo, Kagodo and Makindye hatcheries together with a series of other less capacity ones. Farmers book their day old chick orders directly with the hatcheries or obtain their consignments from distributors appointed by the hatcheries, e.g. Ugachick. There is a very high demand for day old chicks and some companies import day old chicks and sell directly to farmers. There are two hatching days in each week when the farmers can access the

day old chicks from the hatcheries. There being no grand parent stock in Uganda, all hatcheries import their day old chicks from outside Uganda.

2.2.2 Indigenous chicken hatching

On the other hand, most 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. In addition, there is an organized contract hatching of local indigenous chickens using a commercial hatchery owned by the association or using locally made incubators. For the commercial hatchery, the farmers take their eggs to a collection point where they are recorded and marked with the name of the farmer. The eggs are then taken to the hatchery where they are set once a week. Twenty one days later, the farmers come and pick their day old chicks and pay for the hatching (about Ug 200sh per egg set). For those using locally made incubators, the incubator owner buys eggs from the farmers, incubates, hatches, broods (Fig.. . B,C) and grows the chickens for two-three months during which time he vaccinates all the birds against Newcastle and Gumboro diseases. He then sells the birds to the farmers who gave him eggs and any left overs to any willing buyers. At times he gave out growers in exchange of eggs given to him earlier by the farmers.

2.2.3.Hatching of other poultry

As for **turkeys, guinea fowls, ducks and geese**, there were no commercial hatcheries leaving breeding to individual farmers to do hatching at home. There were indications of **ostrich farming** in the districts of Moroto, northern Kotido and eastern Kitgum that were deemed suitable for keeping these birds but details were not available at the time of this report.

2.3 Biosecurity situation

2.3.1 Commercial exotic bird hatcheries

For the **commercial birds**, there is a ban preventing importation of any poultry and poultry products from countries that have reported H5N1 HPAI. This has continued to place very heavy constraints on the production programmes of the Ugandan hatcheries because they cannot import day old breeding chicks from their traditional sources. However, most farmers have now switched to import from clean areas in line with biosecurity requirements. In addition, there is a strict check at the ports of entry to make sure that no day old chicks or any poultry products have entered the country. In this way, the ban has sustained an avian influenza free status in Uganda so far since 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 that may arise from the hatcheries or from the brooding environment. Chick boxes carrying day old chicks were seen on motorcycles which might have carried other goods or people; and at the verandas of distributor shops exposing the young birds to potential contamination with common pathogens that are air-borne (Fig 2.1A).

Although the two commercial hatcheries visited (Ugachick and Biyinzika) had very good biosecurity arrangements, there were some biosecurity issues they could watch. Ugachick have sales offices far too close to the flocks and the hatchery and there is no sanitation facility up to this level for visitors. Feed trucks didn't seem to have been decontaminated although a hand spray pump was there at the entrance. The gates to the breeding farms and the office blocks remained open for far too long (Fig.2.1B). However, good sanitary facilities exist at the flock houses and the entrances to buildings just behind the office blocks. The sales office premises could be relocated nearer the entrance. In addition, they have a feed mill (Fig.2.1C). and a repair workshop so dust and other aerosols find their way into the washing up area for the hatchery. These are structural biosecurity issues which cannot be easily resolved by recommending changes, should an avian influenza outbreak occur. In this case, the hatchery can only rely on stringently observing operational biosecurity measures.

A B C D

Fig 2.1. Showing biosecurity in commercial hatcheries: DOCs cartons on veranda (A), Hatchery gates wide open (B), and dusty feed mill (C) in one hatchery; closed gate and signage at the other hatchery (D).

On the other hand, Biyizinka hatchery more strictly implemented the isolation and traffic control principles of biosecurity at their outer gates (Fig. 2.1D).They had a gate dip for vehicle tires and a separate foot dip for personnel as well as a spray pump to spray the undersides of vehicles. A washing and changing room was located immediately at the gate. Despite all these measures, some flock houses were very close to the gate and a large marsh was immediately next to the flock houses posing great danger from water birds. However, the marshland served as a convenient place to drain into all the waste water from the operations.

2.3.2 Commercial brooder and growers for layers

Some farmers obtain commercial chicks from Kampala, mixed their own feeds, grow the layers up to two months and vaccinate them against Newcastle and Gumboro. They then sell the birds to some farmers and to others they barter feeds for eggs for the farmers who did not have cash. As they deliver the feeds they returned with eggs in the same vehicle. There is here a great danger of disease transmission between the farms under this network due exchange of trays, traffic and a common source of birds and feeds.

2.3.3 Indigenous birds hatched at home

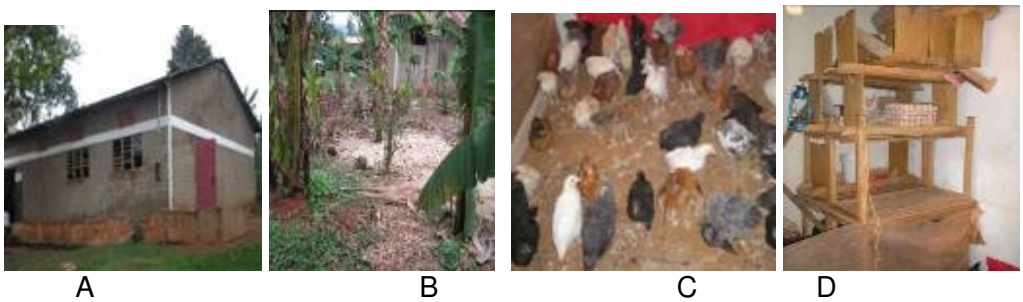
For the indigenous chickens hatched under traditional methods, the greatest biosecurity problem for the day old chicks is the exposure they get to the dirty environment where the adults, growers and other chicks that hatched earlier are already living and soiling the area with their fecal matter or dying birds. Nests may be difficult to keep clean and free of disease. Where Agricultural extension has recruited farmers into improved methods of keeping local chicken, we saw wooden box laying nests in brick walled, concrete floor houses. However, the chickens and their broods

were released into the compound and the farm where other older birds were. At least here the chicks escaped the dirt from soil- based nests and were returning to a clean floor after the day's scavenging with the mother hen.

2.3.4 Indigenous local chickens hatched at a commercial facility.

Here indigenous chicken eggs from diverse sources are pooled together into one incubator for hatching. Initially, the farmers take their eggs in paper trays to the organization's office where they are marked with an identifying farmer's code. The eggs are then transported in the same trays to the hatchery, which is a distance from the office. At the hatchery, the eggs are transferred to plastic hatchery trays and fumigated. The hatchery building has dusty, louver-paned windows which are continuously open to the outside and did not seem to have been cleaned for some time while some panes were broken (Fig.2.2A). Other windows at the back had open grills only which could easily allow birds into the building. The dead in shell eggs were packed in an open tray outside the hatchery building awaiting collection by a pig farmer while the hatched egg shells and other hatching chick debris were disposed in a pit on the premises (Fig.2.2B). There is a gate but it remains open all the time so movement in and out of the hatchery compound is not controlled. There was once a perimeter fence but it is no longer secure. Some farmers source chick boxes from a nearby shop and it was not clear whether the boxes were ever decontaminated before chicks were loaded in.

Should eggs from one farmer be heavily contaminated and the decontamination before setting at the hatchery is inadequate, a breach in biosecurity will occur. Any infection associated with the eggs, hatchery or brought about by workers will now be spread to all farms where the day old chicks will be distributed. Such infections will be a danger to flocks already at the farms. Avian influenza could be spread easily through such a distribution network in the event of inadvertent entry into some point in the network. In addition, we found two month old growers kept at the association's office in the same store where eggs were being received and the day old chicks were distributed from (Fig.2.2C). There was no segregation of clean and dirty operations in relation to DOCs, hatching eggs, maturing birds and other office equipments (Fig.2.2D). However, the DOCs in the cartons were looking bright and clean.



A B C D

Fig.2.2. Showing biosecurity status in the commercial local chicken hatchery: Hatchery building (A), hatch shell debris disposed next to the hatchery (B), two month old birds on the soiled floor at the back stage of the egg store/chick dispatch office (C) and eggs and other office furniture (D) at the ULCFA headquarters deport.

It was clear that most biosecurity issues were breached at the hatchery and the egg/chick distribution point and both are ***serious bio-insecure nodes*** in the local chicken association poultry network and other external poultry operations connected with them.

Table 1. Placement of day old chicks from the local chicken network hatchery over time

Month/year	Number of farmers	Chicks ordered	Remarks
August /09	25	11,510	Placements make period when birds are on the farms coincide with migratory bird arrivals and residence *
July/09	43	19,082	''
June/09	43	15,595	''
May/09	21	6,125	''
April/09	23	5,295	
March/09	10	2,785	
Feb/09	7	1,830	
Jan/09	28	3,085	
Dec/08	5	473	
Nov/08	5	460	
Oct/08	3	1,200	
Sept/08	7	940	
Total	200	68,380	Average holding per farm =342 birds

Legend: * = Birds are kept in the farm up to 4 and half months before disposal. Many farmers are distributed around Kampala with some in far off areas like Mbale. Pathogens from contaminated external environments could reach the flocks where there is poor biosecurity observance.

2.3.5 Indigenous chickens hatched in locally made incubator facilities

Although this is understandably, a very practical and useful innovation, the network of collecting eggs from different farmers and pooling them into one incubator poses biosecurity challenges. Flocks may not be at the same level of hygiene and a breach in one of them will most likely introduce contamination in the incubator. The wooden and clothing materials making the incubator frame and egg trays (Fig.2.3A.) would be difficult to sanitize and decontaminate with ease. Following hatching, the incubator is used to brood the chicks till they are sold out at one, two or three months of age (Figs. 2.3B, 2.3C). Visitors get very close to the birds or may enter into the room to view the incubator. All these activities breach biosecurity principles. Furthermore, we noted that the empty egg shells from the hatching eggs were still on the setter trays one month after the hatching event (Fig.2.3A). Granted that the eggs may all have been fresh and clean it is no big deal. However, the disposal of dead in shell and the incubator powdery waste was not well accounted for which is a serious biosecurity challenge.

On a positive note, it is possible that when the two or three month period during which the local incubator is used for brooding and growing until all birds are sold off is over, the entire system can be dismantled and cleansed by fumigation and use of appropriate disinfectants.

Strict hygiene should be observed by the local chicken hatcheries including use of approved disinfectants to decontaminate the incubators. Plastic egg flats should be used instead of paper trays to transport the eggs.

A B C

Fig. 2.3 Showing hatching of indigenous chicken in a locally made incubator : Clothing, wooden frames and egg shells (A), brooding chicken (B) and incubator exterior (C).

2.4. Recommendations

2.4.1. Hatcheries and commercial flocks

Strict biosecurity measures should be implemented starting at the gates, then flock houses and finally at the hatchery. Appropriate disinfectants should be used in the hatchery and in the flock houses and they should be changed frequently to reduce development of resistant microorganism. Frequent use of soap for washing hands will enhance personal hygiene and assure clean handling of chicks. All these measures will ensure the supply of clean day old chicks free from infectious agents that may emanate from hatcheries, e.g. *Escherichia coli*, *Staphylococcus aureus, Pseudomonas aeruginosa, Proteus vulgaris,* Salmonella and Streptococcus spp and other bacterial agents that cause mortality in young chicks in the first 14 days of life. Day old chicks should be carried and transported from the hatchery to the sales shops or farms in clean chick containers and vehicles. The flow of visiting vehicular and human traffic into the premises should be restricted to places that can be decontaminated. In this regards sales offices be re-located close to the farm entrance. All gates should remain closed when not in use and sanitation facility should be provided for walk-in customers as well as those driving into the compound. The presence of the slaughter house waste water lagoon and the marsh close to the hatchery premises could attract wild birds and these should be monitored.

2.4.2. Commercial local chicken network hatchery

For the **commercial local chicken hatchery** training in and overhaul of all biosecurity protocols regarding hatching egg handling, hatchery hygiene, DOC handling and is required. The association officers require a refresher course in biosecurity issues. The operations are a very weak link in the control of avian influenza in Uganda. Both can be assisted in the above mentioned endeavours by the Government or development partners as part of avian influenza preparedness preparations or poverty alleviation support initiatives. This will assure provision of healthy, disease free indigenous DOCs.

2.4.3. Local home made incubator hatcheries

Stringent biosecurity measures should be observed by the local chicken hatcheries including use of approved disinfectants to decontaminate the incubators and the buildings. Plastic egg flats should be used instead of paper trays to transport the eggs. The operators of the locally made incubators should be trained in biosecurity principles

so that they can decontaminated their equipment and facility appropriately and handle the chicks with appropriate hygiene.

2.4.4. Home hatched indigenous chickens

For the **home hatched indigenous chickens**, provision of clean beddings for the brooding hen and 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. Breeding birds should be sourced from known healthy disease-free flocks and not from the live bird markets. The locally made hatchery operator needs to be exposed to biosecurity issues since he is already aware of some husbandry matters.

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. They are to provide good ventilation; to enable thorough and easy cleaning of the houses; to provide adequate sunlight and sunshine and proper 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, i.e. in general 3 - 4 square feet per bird for layers and 1 square foot per bird for broilers.

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. However, 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. The ideal roofing materials are corrugated iron sheets.

3.2. Actual/Current situation in Uganda

Hatcheries have very well constructed houses with adequate biosecurity provisions including changing rooms for workers and differently coloured uniforms per house (Fig 3.1A). The commercial **broiler and layer houses** have cemented or earth floors. Half the walls are of wire netting while the bottom half is made of brick walling, mud, wooden planks, or iron sheets depending on the financial ability of the farmer (Fig.3.1B, C, D, E, F). Bamboo sticks mat, thatching grass and ordinary black plastic sheets; Bamboo sticks with greenhouse plastic sheeting and corrugated iron sheets are used for the roofing. Coffee or rice husks are more commonly used for the deep litter. One farmer had slatted floors for both broiler and layer flocks in two brick houses and they observed good hygiene (Fig.3.1B). Water is supplied in twenty litre jerry cans with sides cut out, basins, or commercial drinkers all manually filled with water. Feeders are wooden troughs, plastic or metal commercial feeders placed conveniently in the poultry houses. The **layer houses** have additional provision for laying boxes with more space per square foot per bird.

One large-scale broiler farmer had separate brooding houses, and a series of grower houses all made of brick half walls, wire netting upper walls and iron sheet roofing. They had foot baths for each house. There was a perimeter fence and had fenced off the growing from the brooding zones with a clear sign of “No entry” at the gate. Poultry attendants faithfully wore gumboots, used the gate dips and had changes of uniforms. Openings at the bottoms of some doors that could allow rodents into the broiler houses and unkempt stacking of unused feeders and old litter in gunny bags were observed although this farm had excellent biosecurity undertakings.

The same company had a large layer flock of 7000 layers in a separate farm, which had a different manager. Here the houses had brick, timber or iron sheets walling; wire netting with iron sheet roofs. They had dips at the farm gate and poultry house doors while water was given in modified water drinkers. They obtained water from outside the premises, which had potential to ferry in disease. Some migratory birds had made nests in a tree just outside one on the houses, posing a serious threat of avian influenza entry.

One farmer who had a flock of 18,000 layers had two-floor houses all roofed with iron sheets with brick walls and wire netting on the upper halves. To support the weight of the upper deck floor, there were many posts in the ground floor pens. The posts were debarked which would make cleaning much easier. However, they were pretty well soiled with chicken fecal material and so were the perches pinned on them. This farmer also made his own feeds and therefore had a warehouse for raw materials and prepared feeds which was not vermin proof and where wild birds entered freely through openings in the wire netting .

For the **small scale farmers**, the houses had no footbaths. Neither did they practice good personal hygiene, like regular washing of hands; they wore home clothes in the poultry houses and did not wear gum boots, dedicated slippers or head covers. There was no perimeter fencing so chickens from the neighbor just walked into the compounds unhindered.

H**ousing for indigenous chickens** varied from none, where birds slept up trees, in the kitchen or the main house; to separate mud or wooden houses raised on poles; to improved off cut or brick walled houses with cement or earth floors and iron sheets. Some of the mud walls were cemented thus improving sanitation options. The traditional houses seemed rather small for the flocks in the homesteads and there would probably be crowding.

However, the designs of these indigenous chicken houses had particular characteristics that ensured: safety of the birds from animal predators; provided good ventilation, sunshine and sunlight; and gave a good and safe nesting place for hens. Easy spread of disease, difficulties in cleaning and decontamination are the greatest biosecurity challenges here.

3. 3 Biosecurity situation

Commercial hatcheries and large-scale layer and broiler farmers have biosecure housing for their flocks. However, the mud and wooden plank walled chicken houses for the small-scale commercial layer and broiler farmers with bamboo, grass thatch, plastic sheeting and the occasional iron sheet roofing would be difficult to clean and decontaminate. So also would be the raised local stick made houses, kitchens and main house sites when used for keeping chickens at night.

3.4. Recommendations

3.4.1 Hatcheries

Hatcheries and large scale commercial farmers need only refresh their personnel on the required biosecurity procedures applied to housing and carry out regular audits to assure that the protocols are being implemented faithfully.

Fig. 3.1. Showing different types of houses: Breeder flock house (A), small holder broiler brick walled and slatted floor (B) and mud walled (C) houses; improved indigenous layer house of cement screed mud wall (D); wood plank walled with grass thatching (E), bamboo roofed (F).

3.4.2 Small scale commercial farmers

Except for the large-scale broiler /layer farm, the other farmers' houses should conform to the ideal recommendations given above remembering that the house should be easily cleanable and facilitate parasite and disease control. They should provide adequate ventilation, sunshine, sunlight and reduce wind chill. Houses should protect the chicken from predatory birds and animals; adverse weather conditions and theft during the night as well as during the daytime. Laying boxes should be provided. A disinfectant dip should be placed at the door of each house to prevent entry of diseases agents into house. Once depleted of chicken, the houses should be well swept, cleaned properly and decontaminated carefully after the litter has been removed. Access to the flock houses needs to be limited by enclosing the flock houses so that they are not accessible to visitors. Dedicated uniforms or clean clothes should be worn in the poultry house. Portable water should be available for the birds. The guinea fowls, turkeys and geese on the premises of the large scale layer farmer were a serious biosecuirty risk although they were enclosed by a chicken wire netting.

3.4.3 Indigenous chicken farmers

Farmers of indigenous chicken with improved houses should endeavour to cement the floors where this has not been done already and arrange regular cleaning and disinfection. They should fence off the house even if they just use wooden poles or bamboo. This will control traffic and reduce disease spread. Those using traditional materials like mud on the walls could cement these walls which will make the coops easy to clean while those using wooden planks are encouraged to clean and decontaminate them between chicken crops. Those with wooden planks will be asked to do all-in all out placement of chicken after which they can wash the chicken houses with soap and apply appropriate disinfectant. Lime can be put on the earthen floors.

It is difficult to give a recommendation of a common structure since most farmers either do not usually keep the birds as a commercial enterprise and therefore they invest very little in building poultry houses or enter at varying economic levels. However, any of those farmers enlisted in the contract hatching with the commercial or the locally made incubator would be encouraged to use improved houses or cement mud walls to minimize occurrence and spread of avian influenza and other diseases among the network of the farmers. Novel ways to decontaminate the local bamboo, twig and mud made chicken houses need to be sought.

Each house should:

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

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 in freshly cleaned and decontaminated house where adequate warmth, water and feed are need. The day old chicks should be given water on arrival in the brooding house and feed be accessible readily. The wood shavings, rice or coffee husks should be warm to the right temperature prior to the arrival of the day old chicks. It would also include adequate supply water and feed for the brooding and growing period for broilers and the laying period for layer flocks. It would include routine cleaning of the houses and proper litter management and safe disposal of wastes; good work ethics and habits by the personnel, like observing personal hygiene, use of clean clothes, foot-ware and head dress in the poultry houses and disinfectant dips before entering poultry premises. The farmer would be aware of disease prevention issues like vaccinations and treatments, perimeter fencing and safe sales of broilers or eggs.

On the other hand, many of the farmers keeping **indigenous chicken** are not ordinarily expected to have been exposed to any form of training. However, they are free to participate in programmes and training courses that promote safe poultry keeping in their region.

4.2. Actual/Current situation in Uganda

4.2.1. Husbandry in commercial hatcheries

The commercial hatcheries have very good husbandry systems in place. They may however, need planned regular internal audits by themselves and an external audit to assure that the practices are not relaxed. Case in point is the keeping of gates wide open when no vehicles are passing, not decontaminating feed delivery tracks and workers walking out of designated places in internal house uniform mentioned earlier in this report. The flock houses had good husbandry practices. One hatchery, however did maintain stringent biosecurity whereby no vehicles or persons enter unless they are decontaminated and we tasted this during our visit when we were completely refused entry until cleared by the management and then we were guided into the gate dip to decontaminate footwear. They nonetheless have to do regular internal biosecurity audit since casual observations indicated that movement control inside the gates was compromised.

4.2.2. Husbandry in commercial local poultry association hatchery

Many farmers registered with the association brought their eggs to the office and at hatch day came for their chicks. The premises looked clean and breaches in biosecurity would arise due to the many individuals coming from different localities all into one office. There was no provision for decontamination of either foot wear or hands and they didn't seem to change of clothes at the office when handling DOCs. Nonetheless, the network stands high biosecurity risks in the event of an avian influenza outbreak.

Serious biosecurity challenges face the **contract hatching system using locally made incubator**. Here, few if any elements of biosecurity principles were implemented. Eggs were pooled from different farmers; the incubator became brooder and then a growing room. Feeding, watering, and traffic control were hugely inadequate. Water was sourced from an open dam and frequent cleaning of the brooder didn't seem to be in place.

4.2.3. Husbandry in commercial broiler and layer farms

In Uganda, most of the **commercial poultry farmers** have had some exposure to proper husbandry techniques needed for brooding and growing broiler and layer birds. The training is done by hatchery personnel, extension officers, specialized units of Government such as the NAADS and non-governmental organizations. Many of these farmers have brick walled iron roofed poultry houses that are easy to keep clean. They practice very good brooding and growing of both broilers and layer flocks. Broilers were sold live on order and if slaughtering was needed, this was carried out at home. Disposal of dead birds, feathers, offals and wastewater was problematic. While dead birds were buried, feathers remained at the place of slaughter posing biosecurity challenges.

One large-scale broiler (AKONYKORI CO LTD) farm had an extremely well organized, impressive and commendable biosecurity system and husbandry practices, perhaps driven by business gains accruing from the sales of the produce or lessons from losses in the past. Brooding, feeding and watering the growing birds, movement controls, removal of litter and worker habits were good. Hence the good crop of broilers seen. All houses were secure from theft, invasion by rodents and wild birds except some space under the door in two houses that they had tried patching with lose bricks. Waste litter was composted in bags in the compound and sunflower seeds

seen in the open ground next door might attract wild bird into the premises leading to breach in biosecurity.

A sister layer farm located some distance away was equally well observing good biosecurity measures. Their challenge was water pools outside the houses where the jerry cans were being filled in before ferrying them into the houses and a tree with many live nests and noisy migrant birds.

4.2.4. Husbandry in indigenous chickens farms

Most **indigenous chicken** farmers are not exposed to any training on husbandry practices except the few who have joined farmer associations, farmer filed schools or have been recruited into poultry project groups. Here, they are encouraged by different special groups to keep chicken as a business and have therefore been trained in basic husbandry practices. This includes FAO and other development partner supported poultry projects. At least they had improved brick walled, iron sheet roofed houses with laying boxes for layers. However, except for one farmer with the locally made incubator whose birds were entirely confined and fed with home mixed feed, all the others released their birds into the gardens to scavenge for food. The rest of the indigenous farmers reared their birds using their own home-grown skills and let the birds to scavenge for food in the farms.

There are many husbandry based bio-security risks here. Most farmers did not have perimeter fences to their properties so neighbours' chicken just mixed with theirs freely; they did not observe any personal hygiene when attending the birds; they kept birds of different ages all together. Traffic control was not easy and in some farms birds slept in the kitchen or in the main house or up the trees. When the birds are left to scavenge for feeds anywhere in the compound, 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.

4.3. Recommendations

Hatcheries need to audit biosecurity issues and implement corrective actions to improve on biosecurity. The commercial and indigenous poultry farmers require training in good husbandry practices, which will improve bio-security measures markedly. This would include issues such as the proper feed types and timing of feeding; use of clean feeders, water and watering equipment; removal and disposal of dead birds and cleaning of houses and coops; use of clean foot wear and clothing and control of movements so as to reduce disease spread; and keeping of good records. These activities will assist the farmers to reduce the bio-security risks emerging from improper 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 disease outbreaks.

All attractants that may draw wild birds to the farm should be removed, e.g. inadvertently spilled grains or grain spread out to dry; open water spots, wet litter, slaughter wastes and dead carcasses; and trees that may act as nesting sites for wild birds. Trees provide windbreakers and shade for the birds when the sun gets very hot hence their removal is likely to be controversial and should be carefully handled.

5. FEEDS AND FEEDING

5.1. Standard Requirements/Ideal

The commercial hatcheries (**sectors 1 and 2**) usually have access and can follow the feeding regimes recommended by the breeder firms where the day old chicks were sourced. However, the rations are made locally with local raw materials to standard specifications.

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. 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. However, in case the local indigenous birds are confined and fed ready made feeds, such feeds need to be fully balanced in all dietary requirements, just like for the exotic birds.

5.2. Actual/Current situation in Uganda

The hatcheries make either their own feed or source from the commercial millers.
There are many feed millers in Uganda and chicken feed is generally of good quality. There is also a good supply of both layer and broiler feeds for the different age groups reared. The large-scale commercial broiler and layer farm and most of the small scale commercial broiler and layer farms visited used ready made feeds, especially from Ugachick. Many feed shops also keep supplementary mineral and vitamin preparations, which can be given to the birds in the case of stress. However, some layer farmers mix their own feeds at home using locally available raw materials.

5.3. Bio-security risks

5.3.1 Hatcheries
The silos at the Ugachick had lots of dust and the go-down doors were left open for a long time. Wild birds could easily gain access to the feed raw materials. The workers at the feed mill had their lunch just outside the premises where many local chickens roamed. Delivery lorries were not thoroughly decontaminated and they moved into the interior of the farm very close to the layer houses.

5.3.2. Commercial broiler and layer farms

Where feeds used were from biosecure feed millers, biosecurity risks could be minimal. However, b**io-security risks** would arise from the possible contamination of the feed with disease agents coming from exposure of the feed to sick birds or wild birds and rodents invading the feed store whereby the feed gets contaminated with rodent urine and fecal matter containing disease agents. In addition if the feeding and watering equipments are left outside for some time they could get contaminated with

fecal matter or dust laden with disease agents. Water was sourced at times from open dams or from rain water roof catchment tanks that were left open all the time and wild bird droppings could have contaminated it with disease agents (Fig.3.1H). Those who mixed their own feeds or obtained home mixed feeds will have more biosecurity risks since the hygiene for raw materials and during the mixing processes is neither controlled nor assured.

5.3.3. Indigenous birds

For the **indigenous birds** their feed is obtained from scavenging for insects and grains scattered in the farm, food left-overs and green vegetation and finally water from rain water pools in the compound.

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.

5.4. Recommendations

Well balanced fresh feeds should be available to feed commercial layer and broiler poultry. 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. 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 preclude 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 each country disease challenges vary and therefore the diseases included in vaccination programmes will differ. However, generic vaccination regimes are available for hatcheries, layer and broiler flocks. Each country could modify them depending upon the prevalent disease challenge in the country. Proper guidelines are also available on how to dispose litter and dead birds as well as where to obtain treatment for birds should they become sick. Vaccination against HPAI H5N1 is a policy issue determined by respective country's animal health authorities based on policy guidelines from OIE/FAO.

Isolation of flocks to prevent them from being exposed to diseases is highly essential in disease prevention and all farmers would very much benefit by learning and practicing recommended flock health regimes.

6.2. Actual/Current situation in Uganda

Commercial hatcheries have well worked out vaccination and treatment regimes for their flocks and procure timely the vaccines and drugs needed at their farms. 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; Marek's disease; Epidemic tremour; fowl pox; infectious laryngotracheatis; infectious bronchitis; egg drop syndrome-76; fowl typhoid; mycoplasmosis. The local chicken association encourages the farmers in their network to vaccinate their birds against Newcastle and Gumboro while the hatchery operator using locally made incubator does the two vaccinations for the birds he grows at the premises prior to sales at two – three months of age. Animal health professionals are called in to do any vaccinations that are applied through injection.

Farmers keeping scavenging **indigenous chickens** do not usually vaccinate their birds routinely unless there has been a concerted effort to introduce the vaccine in the area whereby they learn the importance add value to the family if more birds survive disease attacks, like that of the fatal Newcastle disease. Currently, farmers under NUSAF, NAADS, Local Chicken Association and some NGOs are vaccinating their birds for Newcastle and Gumboro.

Treatment is carried out in **layer and broiler** flocks for bacterial and protozoan diseases including vitamin-mineral supplementations and there are adequate supplies of the relevant drugs in the drug stores for the farmers to use. Isolation of flocks is a serious flaw in the bio-security status for commercial layer and broiler flock in Uganda 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 flocks. 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. At egg markets, empty trays from the buyers are exchanged for farm trays carrying the eggs to the market, thus taking home foreign empty egg trays of unknown hygiene status. Similarly, if they take many egg trays to a shop, where other farmers also take eggs, they just collect any trays to fill in the number they brought from home, irrespective of whose trays they were.

Manure, slaughter wastes and feathers are disposed in the farm while the dead birds are buried. Wild birds, wild mammals and the domestic pets also have access to most home compounds and the outside of the flock houses. All these activities do not allow the separation of clean birds from sources of disease breaching the most fundamental biosecurity principle.

6.3. Recommendations

Hatcheries are encouraged to adhere closely to recommended vaccination and treatment regimes appropriate for their flocks. L**ayer and broiler** flocks are to be vaccinated against common viral and bacterial diseases. Proper sero-monitoring done regularly will show whether the birds sero-converted adequately to give protective levels of antibodies. Common diseases should be treated using recommended drug dosages to avoid microorganisms acquiring drug resistance, especially to antibiotics

that are also used for human treatment. Drug resistance must be monitored regularly to enable early identification of resistant bacteria that could transfer the resistance to human pathogens and to enable prudent change of disinfectants.

Farmers of indigenous birds who are keeping birds commercially are also using drugs to treat their flocks. Farmers not yet in the networks could be encouraged to vaccinate and treat their birds to reduce losses that would emanate from viral and bacterial infections in their flocks. When they observe reduced losses and increased productivity, they could be attracted to do chicken keeping as a business and a tool to improve their livelihoods.

In order to provide isolation of flocks, the following is recommended:

- That a program be made to educate farmers regarding the role and usefulness of isolation and sanitation and other bio-security measures.
- That the wastes from the slaughtering process, the dead birds, and 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 or other types of fencing be put in place to separate flock areas from areas where visitors have access.
- That dedicated clothing, along with dedicated shoes and head wear which may not necessarily be new and which are not to be used outside the flock house be provided to be used exclusively in the flock houses.
- That a disinfectant dip be provided at the entrance to the flock houses. This can be in the form of a basin with the disinfectant liquid inside.
- That framers be taught to separate clean from dirty work, and that they do clean work first then follow with dirty work; for example collecting eggs and feeding are clean works, while disposing dead birds, removing caked litter from the flock houses and cleaning dirty drinkers are all dirty works.

7. TRADE AND MARKETING

7.1. Standard Requirements/Ideal

Normally it would be expected that a marketing organization would do or oversee the marketing of eggs and meat to provide a stable market through-out the year for the farmers. In addition, traders would be expected to form an organization and build a viable system and network across the entire Uganda. This would stabilize the poultry industry so that trade and marketing issues like prices and policies are uniformly well structured all over the country for equivalent levels in the value chain and that livelihoods of all participants would be improved. Biosecurity matters would be expected to have been installed as deemed appropriate and necessary.

7.2. Actual/Current situation in Uganda

7.2.1 Trade and marketing for hatcheries

Hatcheries import breeder flock DOCs and would easily bring in Avian Influenza in the event the source flock in the exporting country was infected. Where there is a feed mill, raw materials would be received into the premises and bags of feeds would be distributed to various trade points. Commercial layer and broiler DOCs are distributed directly in chick boxes from the hatchery or designated agents all over the country. Slackened biosecurity at the hatcheries would disseminate disease throughout these

networks and cripple the hatchery operations in the event of avian influenza outbreak or the occurrence of other serious poultry diseases.

The slaughter house at Ugachick processed birds from their own farm on separate days and birds from their contract farmers on different days at times regulated by the placement schedules. This way they could control the movements and cleaning of the vehicles transporting birds. The waste water and the blood from the slaughter house joined waste water from the hatchery and the laying houses and was directed through closed channels to a series of fermentation lagoons. The heads went to pig farmers while the intestines were fed to catfish in one of the lagoons. The building and its environs were cleaned and decontaminated regularly. All birds could be traced to source and biosecurity matters at the slaughter house were well in place except the issue of the waste that went to the pigs where biosecurity protocols could be breached. However, in the event of an undetected avian influenza outbreak in any one contract farm the virus could spread easily. Although we did not see any birds at lagoons, there was a mash nearby with some birds and these or others could eventually get to the slaughter house lagoons posing potential risks.

7.2. 2.Trade and marketing for commercial layer and broiler farmers

In Uganda there is no single umbrella organization driving trade and marketing for the poultry industry and its products. However, there is an association for the poultry breeders, the Poultry Association of Uganda (PAU) and one for the local chicken keepers, the Uganda Local Chicken Farmers Association. In this regard, farmers keeping commercial layers individually source for egg markets while the broiler farmers not under the Ugachick contract growing scheme do the same to market their broilers. Eggs are sold at the farm gate, at the local markets and also to targeted restaurants and institutions. As indicated earlier, empty egg trays are exchanged among farmers breaching almost all cardinal biosecurity principles. Even large scale farmers did not escape this practice. Buyers would just walk in with empty trays and walk out with eggs on trays from the farm. Only one teacher farmer in Kasese was the exception as he emptied eggs into a buyer's tray and retained his own trays and this could explain why his trays were unusually very clean. His layer birds looked very healthy and clean too.

Old layers were sold to middlemen who took them to Kampala city on motorcycles and on top of vehicles . Two big live bird markets in Kampala (Kalerwe and Nakawa) had the off layers among the other live poultry. However, cages with off layers were located strategically at a corner in many road junctions in the suburban Kampala, indicating widespread distribution of these birds.

In this cycle, bio-security risks arise in many stages. Starting from homes and the local markets, the farmer is likely to come into contact with infected materials. Their shoes, clothes and headwear also pick up infectious agents from the market. Thus the trays, the shoes and clothes and the vehicles will take back to the home or farm any infectious agents that were picked at the market. Very few farmers will decontaminate the trays that look clean to them unless there are egg breakages that smear the trays and these are also treated as normal. However, if the eggs were from a farm with Newcastle disease or avian influenza outbreak, the fluids from the broken eggs would be carrying a lot of virus contaminating all the trays. Trays and birds from an infected farm would carry infectious material from the farm to the market. Such sick birds would also be discharging lots of virus-laden exudates into the environment along the path to the live bird markets.

For broilers, only a few were found in live bird markets since most are usually sold to specific markets on contract after slaughter or sold alive to target markets where they are slaughtered immediately, like was the case at Namawojolo roadside grilling market. Here, traders were set up as an organization and each day a trader was allowed to purchase and slaughter only four birds and no more (office, birds in 4s and grilled chicken). Middlemen or broiler owners brought birds to the market on a daily basis and sold the targeted numbers only. They would take the rest of the broilers to Kampala or elsewhere. Each trader of "grilled-chicken" was required to have his four birds slaughtered, get meat grilled and sold out completely in the course of the day. No left-overs were entertained, such cases being penalized by reduction of the number of birds they could buy the following day. Since this would reduce the revenue per day, everyone endeavoured to finish selling their quota before the day ended. During our visit at their slaughter house we saw birds in bundles of only fours or less confirming the enforcement of the "rule of four" (Fig.7.1A).

Major bio-security concerns arise at the slaughtering stage where birds seem to have been slaughtered all at once and left on the floor to be defeathered by dry plucking at owners' pleasure; the water to wash the birds needed to be changed more often and looked definitely soiled. The feathers were disposed some distance away from the slaughter slab together with the waste water. However, it was not clear how the heads and offals were, disposed off. The slaughter slab has a smooth floor which was easily cleanable and perimeter wall is good as well as the waste water drainage channel. However, the carcass dressing table was rough and needs some repairs. None of the persons processing the birds had any special protective clothing. They could easily transfer infection from the slaughter slab to local indigenous chickens at the home villages. One bicycle used to bring broilers for sale to the market was still packed at the slaughter slab with one live broiler inside the plastic carrying cage. It was covered with caked bird droppings all over inside and outside and if others were likewise, then biosecurity issues during transportation are of much concern.

A

B

Fig.7.1. Showing trade and marketing: Broiler chicken slaughtering at Namawojolo (A); A live bird market with stacked cages and a lot of clatter where there was no cleaning done at all (B).

7.2.3 Trade and marketing of indigenous chickens and other poultry

Farmers keeping indigenous birds do not have many eggs to sell but when they do so 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 or the buyers bringing in disease to the farm gate or into the farm should they have entered the farm. However, with the integrated contract farming networks in Uganda, this is no longer the case. Indigenous chicken farmers are now keeping flocks ranging from 50 to 1500 and producing eggs that are taken to the incubators for hatching or sold to willing buyers who want to hatch. The cycle here is between the farm and the hatcheries involved. However, growers are also being circulated in the same network introducing some biosecurity flaws. The two month old consignment of birds seen at the offices of the local chicken association had one bird depressed with dropped wings, tails

feathers and closed eyes, while droppings on the floor showed indications of diarrhea in the flock. This is a good source of disease to the target farm and other farms in the network introduced through marketing. If such birds were purchased as replacement stock, they will obviously introduce disease to the new farm, which is a serious flaw in biosecurity for the indigenous chicken farming operations.

The greatest risks in biosecurity and risk for HPAI infection will arise from the trade and marketing of local indigenous chickens. The birds are sold live at the farm gates and the local market where the primary collectors assemble them for further transit to the municipal and city live bird wholesale and retail markets. Bicycles ferry birds to the local markets after which buses, taxis' and motorcycles takeover the long distance transportation to urban markets. Here biosecurity has already been breached by mixing bird transport with human traffic and carrying different species on one vehicle, e.g. chickens and turkey seen on a bicycle at the roadside market in Kumi town or at the Tororo market where chickens, turkeys and guinea fowls were all put in one cage.

Nonetheless, the market in Tororo is to be highly commended on other biosecurity matters because they had entire cage bottoms lined with smooth solid timber which was faithfully swept and washed daily using OMO detergent in contrast to those that did not clean cages at all (Fig.7.1B). They were also organized into a poultry sellers' association. **Their birds looked admirably and commendably healthy and clean.** To improve biosecurity here, it would be advised they apply an appropriate disinfectant to the cages after the washing and then extend the same routine to the floor outside the cages.

The live bird markets are located inside municipal markets (Fig.7.1B) together with other goods for sale or along the roadside in other municipalities but in all cases strategically placed at a corner so buyers do not have to go very far to look for chickens. Although this is a beneficial trade matter, it violates a cardinal biosecurity principle of not mixing poultry with humans, in the event disease occurs in the poultry cages. Therefore, any recommendations on biosecurity will have to be compatible with the regular poultry trade routines otherwise they will unimplementable. The following other biosecurity concerns were observed for live bird marketing:

- Those selling birds along the roadsides did not confine their birds in cages, some arguing that they had just started the business and will buy cages when they get more established.
- Some cages at the markets were made of timber and therefore will be difficult to decontaminate, while carry cages were of bamboo or twisted thin wooden sticks. Some cages were made of flexible wire mesh and had plastic or paper sheets laid on the bottoms making it difficult to clean and keep hygienic.
- In some markets metal cages were either not cleaned at all or cleaning was done irregularly.
- Other materials were strewn on the cages, like waste paper, clothes, and wooden planks and sticks.
- Traders had no special apparel either when selling or when slaughtering the birds, thus they would carry disease agents back home
- No basic preventive personal hygiene, like washing hands before or after handling birds was observed.
- The slaughtering was carried out at an open space next to the bird cages which had no basic cleanable facilities, like concrete floors.
- Defeathering was by dry plucking in most places visited, so the operators would be exposed to chicken dandruff, dust and aerosols from exudates on the chicken feathers if the birds were sick. Such persons would be at high risk of contracting avian influenza were the birds to have been infected with the virus.

- The chicken droppings usually dried and would aerosol into the environment exposing the sellers and buyers to respiratory infections.
- In one bird market the branches of a tree next to the fence overhang the open space where birds were displayed on the ground for sale when removed from the cages and migratory birds perched on this tree when the tree shed it leaves.
- Disposal of feathers and offals was a challenge in most markets.

Trade and marketing of turkeys and guinea fowls was intertwined with that of chickens and so also were the associated biosecurity issues. Ducks and geese, though kept by some farmers for example in Rakai and Kiruhura, were not found in the live bird markets where they would have been freely mixing with other birds within the live bird market. However, they posed a threat for being near migratory bird sites and water points in the associated homes where mixing with wild birds could occur.

All in all, biosecurity seemed to be more of an issue of perception than a science or medical issue as related to the occupation and livelihoods of the farmers and traders. Therefore any recommendations, regulations or actions intended to resolve or assist in implementing biosecurity matters that does not address this perception dimension may not drive home biosecurity control.

7.3. Recommendations

For hatcheries:

- All hatcheries for commercial and local chickens should have standard operating procedures in place that assure that biosecurity issues are implemented effectively and are regularly audited for efficacy. This way DOCs of all types do not become vehicles of spreading disease through trade. Likewise sanitary measures be put in place at the offices and originating farms of the Uganda local chicken farmers' association growers re-distribution birds to avoid disease spread.

For layer farmers and those trading in eggs:

- Farmers and traders selling eggs are to desist from exchanging their egg trays with empty ones from the buyers. They could invest in plastic trays which are easy to clean and decontaminate.

- Farmers and those trading in eggs made aware that during the process of marketing eggs, they encounter many potential bio-security risks and flaws that can bring disease to their flocks and also to them.
- To avoid such spreading of disease they should wash their hands regularly with soap after coming from the markets and not use the same clothes and shoes that went to the market but use clean or dedicated clothes and shoes left at home.
- They should use disinfectants to decontaminate materials and equipment that has gone to the market before it is re-used at the farm.
- They are to decontaminate vehicles and cages used by those coming to purchase off-layers at the farm; and if the farmer took off-layers to the market and some birds were not bought, the remaining ones are to be quarantined at home in a place away from and are not to be returned to the flock houses.

For the broiler farmers and traders:

- Broiler farmers should ensure buyers coming to their home decontaminate their footwear and are handed the sale birds at a place not endangering the remaining flocks.
- Traders transporting broilers to the Namawojolo and other markets should use clean cages which are decontaminated after the visit to the slaughter houses and the markets.
- The municipal authorities and the Namawojolo trader's committee need to espouse procedures that ensure the slaughter premises are kept clean and decontaminated before and after the slaughtering process; that offals and heads are appropriately disposed off and that the feathers/waste water disposal system is decongested by removing the accumulating wastes and it be sanitized at regular intervals; ensure that some uniforms are worn by those who slaughter and grill birds. this would not be a new item since those members of the association selling other materials already had uniforms.

For the farmers and traders of indigenous chickens:

- Farmers of indigenous birds in the Uganda Local Chicken Farmers' Association network are to preferably use plastic trays which can be easier to clean and decontaminate when they take their eggs to the hatchery. Birds traded as growers are to be treated for common poultry diseases before they are circulated to new owners.

- Individuals purchasing mature birds at the farms of the ULCFA network or those of ordinary indigenous chicken farmers are to decontaminate footwear and be handed the birds away from the flock houses.

- Introduction of a rest day per week for thorough cleaning and disinfection in all live bird markets.
- Transport of birds be in cages that can be cleaned and decontaminated and should preferably not be in the same vehicle as humans.
- for sale be contained in cages, even those sold at roadside markets.
- The cages for roadside sales be constructed so that the bottom has two layers of wire netting at least 2-3 inches apart. Of these the upper layer to have smaller spaces in the grid to hold the chicken feet firmly. A plastic sheet is placed over the most bottom layer to collect droppings and can be removed for cleaning and disinfection. This leaves the birds free of fecal material, very clean and attractive to customers. Such birds will not carry a lot of fecal material to the slaughter house reducing human food contamination.
- Cages at the markets if single be constructed as given above. If stacked they should have solid wooden planks covered with water resistant paint.
- Cages should be swept, cleaned and disinfected daily.
- Cages were in a roofed shed in two of the markets visited. This should be emulated in other markets.
- Slaughter slabs at the markets be cleanable and disinfectable. Facilities to dispose waste water and solid wastes be provided.
- The location of the live bird markets should preferably be away from the main market for other goods and large crowds. However, in one market we were informed that the live bird market was outside on the roadside but it had to be brought inside the main market. Due to the nature of the goods being sold, these live markets are likely to be found where large crowds are. Therefore what is likely to have impact is to make the traders aware of the value of biosecurity to their trade and livelihoods, train them and support them during the initial period of the implementation process. Since some are already practicing some biosecurity matters the adoption may be easier.

- Legislations be made to provide for:
    - The establishment, licensing, operations and inspection of hatcheries.
    - The establishment, licensing and operations of commercial and municipal local chicken slaughter houses.
    - The regulation and supervision of the transportation of live poultry.
    - The inspection and certification of slaughtered poultry.
    - Traceability of birds that are slaughtered via the transportation routes to their original homes.
- Live bird market traders be financially and technically assisted to learn and to establish biosecurity measures at the live bird markets and to develop the relevant standard operating procedures.

8. ANIMAL- HUMAN HPAI: TRANSMISSION

8.1. Standard Requirements/Ideal

Transmission of avian influenza H5N1 to humans is believed to take place after very close contact between the infected poultry source and the persons exposed. In this regard, those at risk would be persons at live bird markets, slaughter houses, poultry houses and any other such circumstances in which an individual spends some time in close proximity to infected birds.

8.2. Actual/Current situation in Uganda

Currently Uganda is free of avian influenza. However, was 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 carry infected birds in the vehicle or in any of its carriage compartments; and transporters of live birds on bicycles and motorcycle.
- Buyers and sellers at live bird markets wherever the latter are located.
- Any persons exposed to the aerosols and droppings from the cages and the open space at the live bird markets.
- Workers in the chicken slaughtering facilities, whether they are big, like Ugachick or they are small like the road side markets, Namawojolo chicken grilling center or the slaughtering premises at various municipal live bird markets, irrespective of whether dry or wet defeathering methods are used.
- Persons who may sleep in the same house with an infected chicken.
- Persons who may inadvertently handle any infected live or dead birds.
- Persons who may consume infected birds or raw chicken offals, meats or undercooked chicken meat or infected raw eggs and or products made from raw or semi-cooked infected eggs.
- Any persons who may be involved in disposing slaughter waste and offals of infected birds or litter from infected premises.
- In some rural areas, and this is not unique to Uganda alone, chickens were believed to be incapable of transmitting diseases to humans. Therefore birds were edible meat be they live and looking normal, sickly or dead. Birds that would be sick or dead from avian influenza would pose a special danger to human health in such communities. A more common phenomenon is the

consumption of the special delicacy known as ***'KIKOMANDO'***, a sandwich combination of wheat flour pancake called ***"CHAPATI***", and fried eggs. There would be possible danger and risk of exposure to HPAI for consumers and those preparing ***KIKOMANDO*** should the eggs be infected since the frying may not be complete when the egg is placed on the ***"CHAPATI".***

8.3. Recommendations

It is recommended that:

- Transportation of live birds in the same vehicle as humans be minimized.
- Persons working in poultry houses, live bird markets, slaughter houses and buyers of poultry at any source be made aware of the potential to be infected with avian influenza.
- All such persons be trained in basic preventive biosecurity methods, like washing hands frequently before and after handling poultry or their products; use of simple equipment for disinfecting
- Any of the circumstances listed in section 8.2 above be considered likely to be at risk of exposure to and be closely monitored for avian influenza.
- Since non waterfowl, like the home crows were found in Hong Kong to be positive to H5N1, and that such birds may be found together with domestic chicken in small urban damp sites, other novel means of transmission may arise if these birds get into contact with infected migratory species bringing in unfamiliar routes of transmission that require attention.

9. CONSUMER PROTECTION

9.1. Standard Requirements/Ideal

When considering consuming poultry products, what comes to mind immediately are the traditional cuts of the chicken meat and eggs either boiled or prepared in the usual recipes. Perhaps it may be helpful to consider that other parts of the chicken may find their way into the informal markets and that recipes may vary in different countries exposing novel ways and dangers of transmitting disease to those who may get in contact with these products.

9.2. Actual/Current situation in Uganda

A lot of chicken meat is consumed in Uganda coming from broilers, spent (old)-layers and indigenous birds. It is not clear what proportion of this is inspected other than the birds that are slaughtered at the commercial broiler slaughterhouse.

There was no officially regulated municipal chicken slaughter houses in most of the municipalities visited. However broilers were slaughtered daily in large numbers at Namawojolo, grilled immediately and sold on the roadside to travelers and other customers. Broiler farmers also slaughtered their birds at home and sold the meat to targeted customers. There were reports of off-layers being slaughtered at home.and biosecurity risks were like those of home slaughtered broilers. Moreover, many chicken kiosks in Kampala and its suburbs kept off-layers for sale and it is believed that once bought the birds were most likely slaughtered nearby or anyway they would

be slaughtered at the buyers' homes. The consumers carry the food quality risks that would be associated with these poultry products.

There is no formal inspection and certification carried out for eggs that the author is aware of except for the grading into small, medium and large. Cosmetic cleaning of mildly soiled eggs is done prior to putting the eggs in trays for the market while. Boiled eggs were sold at bus stages while the delicacy, "KIKOMANDO" mentioned earlier were also prepared in the open using eggs. Infected eggs are difficult to identify unless the eggs are cultured, and such eggs are likely to pass the infection to the consumer if undercooked.

9.3. Recommendations

- Mechanism be established to find out the distribution of all products emanating from the process of slaughtering chicken and how they enter into the human food chain with a view to the protection of human health and H5N1 transmission.
- Ways be established for the inspection of the diverse poultry products as being fit for human consumption and free from spreading H5N1 to humans.
- 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

The major reservoirs of avian influenza in the wild are believed to be both resident and migratory birds, especially waterfowls and shore birds. These are most likely to introduce the avian influenza virus into new territories. 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. However, other wild birds, like house crows, Crested Myna, sterlings have been found infected with H5N1 virus in Hong Kong ( ). The avian influenza virus does not produce severe disease in wild birds; there are also other low pathogenic avian viruses which can be found in healthy looking wild birds. Any country that lies in the flyway of the migratory birds is at great risk of getting the virus introduced into the wild bird population and eventually into the domestic flocks with consequential dramatic and drastic impacts.

10.2. Actual/Current situation in Uganda

Wetlands are home to many resident waterfowls and other birds in Uganda. 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 many Uganda wetlands and designated Ramsar sites. However, results of wild bird surveillance studies have so far not indicated the presence of H5N1 HPAI.

There is evidence of domestic birds mixing with wild birds, like crows, marabou storks, sterlings, and pigeons although the birds may not be the waterfowl that are supposed to be the classical carriers of avian influenza viruses. Nonetheless, some of them have been shown to be positive for H5N1 in Hong Kong in each of the years of 2006 to 2008 while outbreaks were being reported and may therefore be a source of the virus and

stealthily introducing it into Uganda (Table 2). It is worth noting that all the Hong Kong birds were negative when sampled prior to the 2002-2003 outbreaks. Since Uganda also lies along the Mediterranean flyway to South Africa, it is therefore at high risk of getting avian influenza introduced via the migratory birds.

There are many scavenging indigenous chickens in homes at Entebbe very close to the Lutembe Bay, which receives several million migrating birds annually; and in Kasese, Mbarara, and settlements around Lakes George and Mburo where the other birds in the Hong Kong list (Table 2) have been sited. If droppings from these wild birds could land in these homes chances are that the virus would be seeded into the domestic flocks directly. This is an unusual and unexpected entry route that requires monitoring.

10.3. Recommendation

- Studies be done to establish exactly which migratory birds do mingle with the Ugandan wild birds and particularly any birds that are in the Hong Kong list. Further, it be established which of these have access to homes with commercial or scavenging chickens or live bird markets where there could be free mixing or depositing of infected droppings that would bring avian influenza virus into the domestic stock. This data will assist in refining the HPAI risk maps as well as surveillance.
- Satisfactory biosecurity measures be established and monitored in the commercial flocks that are located close to lakes George and Edward, Lakes Mburo, Nabugabo, along Lake Victoria and other bird landing sites.
- Scavenging chickens in Entebbe homes near Lake Victoria bays be monitored for avian influenza.
- Surveillance for antibodies to and presence of NC disease virus in scavenging chickens having no history of vaccination that are in Entebbe homes near the Lake Victoria bays and those in homes close to other bird landing sites be sampled as proxy to detect potential for avian influenza virus occurrence

Table 2. List of wild birds positive for H5N1 in Hong Kong during disease outbreak years of 2006 to 2008*

Bird's name	Year of sampling in which they were virus positive			Situation in Uganda / Place they are to be found**
	2006	2007	2008	
Pelegrine Falcon	+	+	+	Recorded in BI, QE, LM, MF, KV
House Crow	+	+	+	Commonly seen in towns and rural areas; at damp sites.
Little Egret	+	+	-	Recorded in SE, LM, KV; and seen in QE, LM.
Great Egret	-	-	+	Recorded in SE, LM, KV ; and seen in QE, MF,
Grey Heron	+	-	+	Recorded in SE, LM, KV ; and seen in QE, MF,
Common Kestreel	-	+	-	Recorded in QE, KF, LM, MF, KV.
Common Buzzard	-	+	-	Recorded in BI, QE, SE, KF, LM, MF, KV.
Common Magpie	+	+	-	Birds not identifiable in the checklist.
Munia	+	+	-	" " " " " " "
Oriental Magpie robin	-	-	+	" " " " " " "
Blue Magpie	-	+	-	" " " " " " "
Red billed Starling	-	+	-	" " " " " " "
Scally breasted munia	-	+	-	" " " " " " "
Long tailed Shrike	-	+	-	" " " " " " "
Crested Goshawk	-	+	-	" " " " " " "
Crested munia	+	-	-	" " " " " " "
Large billed crow	+	-	-	" " " " " " "
Crested myna	+	-	-	" " " " " " "
Magpie Robin	+	-	-	" " " " " " "

Legend: * = List of birds positive to H5N1 (Source : Smith GJD, *et al.*, 2009).

** BI = Bwindi Impenetrable; QE= Queen Elizabeth ; LM = Lake Mburo; SE = Semliki; MF = Murchison Falls; KV = Kidepo Valley national parks in Uganda.

11. LEGISTATIVE ISSUES

11.1 Standard Requirements/Ideal

Legal provisions are expected to be available to control animal diseases and regulate activities in the poultry industry including movement, trade, establishment and management of live bird markets, import and export of poultry, eggs and poultry products and provisions for licensing of poultry slaughter houses and the inspection of slaughtered poultry and the management of transboundary diseases, epidemics and pandemics.

11.2. Actual/Current situation in Uganda

11.2.1The Animal Diseases Act 1964: CAP 218

The control of the diseases for all animals in Uganda is regulated by the Animal Diseases Act of 1964. The act contains the rules and regulations concerning disease control and the issues on procedures for importation and export of animals and animal products. The act also contains the roles of the different officers in disease control such as the Commissioner of Veterinary services, Veterinary Officers, Law enforcement agents and the powers of the Minister in the determination of contraventions. It empowers the Minister to make regulations on the importation,

exportation and the management of any disease outbreak of national economic importance by control or eradication measures including movement restriction.

11.2.2 Definitions

Under this Act "**animals**" mean stock, camels, and other ruminating animals, cats, and dogs abut does not include any other animal except such as declared by the minister by statutory instrument to be included in the term animals for the purposes of the Act where "**Stock**" includes cattle, sheep, goats, mules, donkeys, swine and poultry"

"**Diseases**" definition does not include any other disease except such as may be declared by the minister by statutory instrument to be included in the term diseases for the purposes of this Act. Under statutory instrument 218-2, disease was re-defined to include Newcastle disease as the only poultry disease.

"**Poultry**" means all domestic or domesticated fowls, ducks, geese, turkeys, guinea fowls, peafowl, pheasants, pigeons, ornamental or caged birds but excludes, " quails and doves". Quasi-domestic birds like Ostriches are not included either.

11.2.3 Recognition of AI as disease

Although poultry are defined among the stock, only Newcastle disease is included as a disease under this Act. However, HPAI has now been included as a disease under Statutory instruments 2007, number 46 which has so far facilitated the effective management of HPAI.

This is has now harmonised the position of Uganda as a member country to the world Animal Health Organization (OIE) that categorizes various diseases according to their impact (including all list A diseases where AI is listed) and requires the member countries to make or update regulations regarding decisions made at the international committees of the organization to operationalise the decisions made by the organization. The OIE develops generic documents relating to rules that member countries can use to protect themselves from the introduction of diseases and pathogens, without setting up unjustified sanitary barriers. The main normative works produced by the OIE related to disease control including avian influenza are the Terrestrial Animal Health Code and the Manual of Diagnostic Tests and Vaccines. Under these guidelines each member country is obliged to undertake to report the animal diseases that it detects on its territory. The OIE then disseminates the information to other countries, which can take the necessary preventive action. This information also includes diseases transmissible to humans and intentional introduction of pathogens. Information is sent out immediately or periodically depending on the seriousness of the disease. This objective applies to disease occurrences in all circumstances.

11.2.4. Amendments to the Act and provisions by other Acts

There have been efforts to make amendments to the Act to align it with global developments in the livestock industry but this has been slow and this is yet to be done. **Statutory instrument 218-4** which concerns animal diseases rules underlines the regulations regarding importation and exportation of animals, animal products and biological products, imposing/removing quarantines, examination of animals, places of import, and outlines the requirements for permits to this effect which MAAIF used to impose bans on importation of poultry following threats of AI from countries that reported AI or to lift the ban. It also outlines the powers of all persons involved in

regulating the system such as inspecting officers, the commissioner of veterinary services, the courts of law etc.

The above not withstanding, the Act and other regulations and related Acts (such as **the Animal prevention of cruelty Act, the Public Health Act) contain several provisions that would enable MAAIF to respond to animal disease threats including the recent threats of H5N1**. **The Animal prevention of cruelty Act** provides for modes of transportation which not only prevents cruelty to the animals but protects the animals against exposure to diseases during transportation as well as would be the case with AI. The Acts provide for manned control and monitoring posts, listed in schedules and stipulates sanctions for contraventions and also it does provide for ***disposal of carcasses,*** compensation at the discretion of the veterinary officer, as well as communication to farmers in the area about outbreak of diseases and responsibilities of the local authorities. The Public Health Act further provides for inspection of animals intended for human consumption, slaughter houses, butcheries and the management of nuisances, such as manure, noxious waste solids and liquids.

However, all these provisions are designed for mammalian stock and exclude the provisions that specifically address the unique aspects of production, trade, transport, marketing, slaughter and sales in the poultry industry. Furthermore, they are structured in the punitive genre to catch those breaching the rules but not to provide what can be done to positively encourage healthy progress in the industry.

Copies of several policy documents, strategies, regulations, statutory instruments and Acts are available with MAAIF.

11.3. Recommendation

Under the appropriate act, rule be made or statutory instruments be declared to provide for:

- Legislations regarding the establishment, running and inspection of hatcheries, poultry slaughter houses and live bird markets.
- Legislations to regulate the transportation of live poultry; trade in live bird markets, and the disposal of dead poultry and slaughter wastes at live bird markets
- Legislation to provide for HPAI, LPAI and other poultry notifiable diseases
- Legislation to provided for inspection and certification of slaughtered poultry.
- Legislation to declare Ostriches as poultry for purposes of avian influenza disease control.
- Legislation to establish poultry feed standards and to regulate operations of feed mills be to reduce introduction of avian influenza through contaminated feed.

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13. APPENDICES

13.1 TERMS OF REFERENCE

International Consultant

Poultry Sector Analysis: Bio-security Review and Improved Poultry Husbandry Systems for Sectors 3 and 4 to Prevent HPAI Infection

Job description

Under the technical supervision of the National Project Coordinator and in close collaboration with the Regional ECTAD Coordinator, the international consultant will prepare comprehensive analytical review of the Bio-security and Legislations related to the poultry industry in Uganda with regards to HPAI risk (Description of the Poultry Sectors has already been done).

Specifically the Consultant shall:

1. Identify areas of possible bio-security risks in the production chain in each of the poultry production sectors (see Appendix for definitions of the sectors).

2. Prepare a report on Bio-security in all the Poultry sectors. The Review shall have information on the identified HPAI bio-security risk points in the Production chain of each Sector.

3. Make recommendations on how to improve Biosecurity in the poultry production sectors 3 and 4.

The length of the Review Reports shall be 40 – 50 pages (font 11 Arial) and the content, in agreement with the responsible FAO officers and the Regional coordinator. The Report shall be provided in electronic format (MS Word).

FAO will provide to the International consultant the Poultry Review report on Poultry production in Uganda.

Duration: Four weeks from the signature of the contract.

Qualifications: Veterinary science expert with postgraduate qualifications. The Candidate shall have at least 8 years of field experience in poultry production in developing countries

The consultant will have to be able to respect working timeframe allocated to the job and the deadlines set.

Place: Uganda will be the working place of the consultant with travel throughout the country to assess the biosecurity risk along all the production chains of the entire poultry industry in Uganda.

Language : English.

13.2 POULTRY SECTORS: SHORT DESCRIPTIONS OF EACH OF THE FOUR SECTORS

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 Biosecurity 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 or 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.

Sector4B: 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.

13.3 HIGH RISK PRACTICES/SITUATIONS IN THE POULTRY VALUE CHAIN IN UGANDA AND POSSIBLE REMEDIES

Commercial hatcheries

- Traffic control and sanitation at gates inadequate for some premises
- Keeping gates open too long after entry of delivery vehicles
- Inadequate sanitation for vehicles and persons entering premises
- Traffic control relaxed
- Waste water lagoons and wetland marshes near premises
- Presence of local scavenging birds in the vicinity of hatchery premises.

Hatcheries for local chickens

- Disposal of hatchery waste in the compound of the premise
- Two month local chicken growers, DOCs and eggs in one room
- Hatchery waste disposed in the same compound very close to the hatchery building;
- Dead in shell in an open tray outside near hatchery door awaiting collection by pig farmers
- Waste disposal near hatchery building
- Dusty and unsecured hatchery building
- Hatchery construction materials not easy to decontaminate and likely to spread disease in future hatches
- Fish pond water used for grower chickens to be sold later to farmers

Layers and broilers

- Exchange of egg trays at the market and farms
- Paper trays carrying eggs to the local chicken hatchery not decontaminated
- use of water from open wells and fish ponds
- Return of trays and bird cages from across the borders
- Feed ingredients exposure to wild birds
- Open water reservoirs in the homes
- Mixed species farming in the same farm
- Open holes in the wire mesh in poultry houses may allow entry of wild birds
- Trees that attract visiting migratory birds to nest in the home of the farmer
- Pools of water in the compound that attract wild birds
- Wild birds readily accessed grains meant for feeds being dried in the open
- Non vermin proof houses storing feed attract rodents and wild birds
- No dips at the farm house entrances
- Traffic control and segregation not practiced
- Disposal of offals, manure, slaughter wastes and feathers after home slaughter done in the farm and near poultry houses.

Live bird markets

- Live birds taken to the sides of vehicles for sale
- Location of live bird markets in high density and high traffic market zones.
- Cages at live bird markets had birds all days of the week
- No day to clean and decontaminated cages so as to break disease cycles
- Dry de-feather slaughter dispersal of feathers all over the market place
- Cages made of wood not easy to clean.
- Those made of metal not cleaned and disinfected regularly
- Walk way corridor at the live bird markets between cages and buyers not cleaned regularly, nor disinfected
- Mixed species in same cages at the live bird market

- Wild bird perches at the live bird markets
- Transportation of birds in vehicles carrying people and in the open on vehicles, bicycles and motorcycles.

Indigenous chickens

- Open air transportation of egg trays, day old chicks and returned egg trays which may be carried in the same vehicle that carried other materials to the markets
- Transportation of birds in the same vehicles as human beings, in the open on vehicle carriers, and motorcycles
- Mixed species in the same farm or market cages or being transported together.
- Farming on double decker housing without due hygienic measures, especially mixing ages
- Wild birds feeding on grains to be used to make chicken feeds
- Wild birds mixing with market birds

Husbandry

- Inadequate application of basic biosecurity principles in handling chicks, egg trays, birds at live bird markets and during transporting; in the processes of slaughter and in the management of scavenging chickens in the village setting.

Human transmission

- Husbandry practices in homes, close exposure to birds during transportation, different transportation methods used, lack of incorporating basic biosecurity practices when keeping birds and during trade and slaughter at live bird markets exposes high risks to human infection with H5N1 avian influenza.

Ecology, wetlands and wild birds

- Wetlands and migratory birds landing sites many
- Migratory birds over-flying commercial and local scavenging chicken farms.
- Presence of birds in wetlands, national parks and urban areas known to have been positive for H5N1 virus during Hong Kong outbreaks of 2006 – 2008
- Cattle belt a possible sink that may absorb fecal droppings bearing H5N1 virus from migratory birds and prevent infection of domestic poultry. It may also act as a barrier to prevent rapid spread of disease between regions.
- Ostrich farming in the north east at risk if avian influenza H5N2 subtypes appear in the wild birds; and ducks and geese in Rakai and Kiruhura farms might mix with wild birds in the home ponds and be exposed to H5N1 infection.

Remedies

- Involve the stakeholders at each level of the value chain to discover the underlying socio economic forces behind their actions at the respective level.
- Involve these stakeholder in developing biosecurity training modules that respond to the socio-economic issues relevant to that level in the value chain
- Use examples of benefits accruing from successful application of biosecurity principles; and losses accruing where they are not applied using live current examples, respectively, e.g. the healthy and good flock at the broiler farmer, and very clean birds being quickly bought at one live bird market with good biosecurity principles; as opposed to sick birds which were not being bought quickly at where cages dirty and no biosecurity was observed to drive home biosecurity messages.
- Develop biosecurity standard operating procedures SOPs for use at each level.