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HPAI PRO-POOR HPAI RISK REDUCTION

Qualitative Release Assessment of the Risk of Re-introduction of HPAI H5N1 Virus from Neighbouring Countries into Ghana via Cross-border Trade and Movement of Birds and People

Paa Kobina Turkson

Africa/Indonesia Team Working Paper No.20

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Preface

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

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

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

To facilitate the development of evidence based pro-poor HPAI control measures the project is designed so that there are five work streams: disease risk, livelihood impact, institutional mechanisms, risk communication, and synthesis analysis. Project teams are allocating and collecting various types of data from study countries and employing novel methodologies from several disciplines within each of these work streams. So that efforts aren't duplicated and the outputs of one type of analysis feeds into another the methodologies in each work stream will be applied in a cohesive framework to gain complementarities between them based on uniformity of baselines and assumptions so that policy makers can have consistent policy recommendations.

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Disclaimer

The views expressed in this report are those of the author and are not necessarily endorsed by or representative of IFPRI, or of the cosponsoring or supporting organizations. This report is intended for discussion. It has not yet undergone editing.

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More information

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

Executive Summary

By December 2007, there was a continuum of Highly Pathogenic Avian Influenza (HPAI) H5N1 affected countries along the West African coast from Cote d'Ivoire to Cameroon. In all, 8 countries in West Africa had recorded HPAI H5N1 (Niger, Burkina Faso, Cote D'Ivoire, Ghana, Togo, Benin, Nigeria, and Cameroon). There is concern about the danger posed by circulation of the virus as these countries are members of ECOWAS and there is constant movement of people and goods and trade between them. At a workshop in Accra in November 2008, participants identified re-introduction of the virus into Ghana as a major challenge.

The risk question posed was "What is the risk of re-introduction of HPAI H5N1 virus from neighbouring countries (Burkina Faso, Cote d'Ivoire and Togo) into Ghana via cross-border trade and movements involving live birds, poultry products and fomites?". Three release risk pathways involving Cote d'Ivoire, Burkina Faso and Togo were developed. A questionnaire was developed to elicit responses from identified experts to provide information. Credible information was received from Cote d'Ivoire and Burkina Faso. There was no response from Togo. A qualitative risk assessment following the OIE framework was undertaken to address the risk question.

The qualitative risk estimates for the release pathways ranged from negligible to very low with high uncertainty. During outbreaks in neighbouring countries when birds are infected, the risks will vary and are likely to be higher. The highest risk of re-introduction of HPAI H5N1 virus to Ghana is the pathway involving cross-border trade and movement of poultry, poultry products, people and fomites from Cote d'Ivoire with risk estimates being negligible to medium. This is because poultry and poultry products are illegally sent into Ghana (despite a ban on poultry and poultry products) and the existence of farms along the border in the two countries under similar management and therefore sharing facilities. The steps of the pathway for the re-introduction from Cote d'Ivoire to Ghana associated with higher risks included the probabilities of introduction of live birds, eggs and egg trays, and day-old chicks and the probabilities of contamination of traders and poultry workers on small farms. From Burkina Faso, the steps with higher risks posing a threat for re-introduction of HPAI to Ghana included the probabilities of introduction of live household birds; the probability of transporting guinea fowl eggs; the probabilities of contamination and transporting of baskets used for live birds and egg containers; the probability of traders using vehicles to markets and the probability of maize being imported for use as poultry feed. From Togo, the steps with higher risks posing a threat for reintroduction of HPAI to Ghana included the probability of introduction of live household birds; the probability of contamination of poultry workers and the probability of importing frozen turkey tails and carcasses. These could be targeted as preventive or critical mitigation points.

The high level of uncertainty associated with most of the risk estimates point to significant gaps in knowledge of the epidemiology of HPAI and/or poultry production or trade in West Africa. Therefore the risk estimates have to be interpreted with extreme caution. There is the need for targeted data collection to fill some of the relevant knowledge gaps. The particular areas are the prevalence of HPAI in household birds and wild and scavenging birds, and movement patterns of people and poultry and poultry products across the borders.

Abbreviations

AI	Avian Influenza
AIWG	Avian Influenza Working Group
BF	Burkina Faso
CEPS	Customs, Excise and Preventive Services
CI	Cote d'Ivoire
CVO	Chief Veterinary Officer
DOC	Day-old chicks
ECOWAS	Economic Community of West African States
EFSA	European Food Safety Authority
FAO	Food and Agriculture Organisation of the United Nations (UN)
GIS	Ghana Immigration Service
HPAI	Highly Pathogenic Avian Influenza
MOFA	Ministry of Food and Agriculture
MOTI	Ministry of Trade and Industry
NMIMR	Noguchi Memorial Institute for Medical Research
OIE	Office International des Epizooties
PFW	Poultry farm workers
VCA	Value Chain Analysis
VSD	Veterinary Services Directorate

Glossary and Definitions

Exposure: The condition of being subjected to a source of risk.

Exposure assessment: The process of describing the biological pathway(s) necessary for exposure of animals and humans in the importing country to the hazard (in this case the pathogenic agent) released from a given risk source, and estimating the probability of the exposure(s) occurring, either qualitatively or quantitatively.

Fomite: A fomite is any inanimate object or substance capable of absorbing, retaining, and transporting contagious or infectious organisms (from germs to parasites) from one individual to another.

Poultry: According to OIE and in line with the revised legislation for the control of AI (EC, 2005) 'poultry' is defined as 'all birds reared or kept in captivity for the production of meat or eggs for consumption, for the production of other commercial products, for restocking supplies of game, or for breeding these categories of birds'.

Release: Release is defined as covering all biological pathways necessary to lead to the "importation" of the virus to the EU (OIE 2005). The release assessment includes the estimation of the probability for this entire process. It considers how it can be affected by various factors including risk management measures.

Release assessment: The process of describing the biological pathway(s) necessary for an importation activity to "release" (that is, introduce) pathogenic agents into a particular environment, and estimating the probability either qualitatively or quantitatively, of that complete process occurring.

1. Introduction

1.1 Context

In Africa, the first outbreak of HPAI H5N1 was reported on 8 February 2006 in Kaduna State, Nigeria. Between February and May 2006, there were other outbreaks in Egypt, Niger, Cameroon, Burkina Faso, Cote d'Ivoire, Sudan and Djibouti. The presence of HPAI in two of Ghana's three neighbouring countries and two other sub regional countries (Niger and Nigeria) and the close link by trade between Ghana and Nigeria caused concern in Ghana. Ghana placed a ban on the importation of all live poultry, poultry products and by-products from countries reporting outbreaks of HPAI H5N1 at the beginning of AI outbreaks all over the world. The countries that border Ghana are Cote d'Ivoire, Burkina Faso and Togo. Cote d'Ivoire had an outbreak in the Abidjan area in May 2006. Burkina Faso had an outbreak in April 2006 at Houet, Kadiogo and Sanguie. The outbreaks in Togo were at Siegbehoue and Agbata (Lacs, Region Maritime), and Tonoukout (Zio, Region Maritime) in June 2007.

In April 2006, a nation-wide active surveillance for avian influenza in both domestic poultry and wild birds populations was undertaken in Ghana during which about 2000 samples from domestic and wild birds were collected and tested for the presence of HPAI H5N1 virus. All samples were negative for AI type A viruses.

During the same period (April 2006), both Burkina Faso and Cote d'Ivoire had reported outbreaks of HPAI H5N1 in their respective countries. As part of preventive measures against HPAI, the Veterinary Service Directorate (VSD of MOFA) monitored the movement and trade in live birds along its borders with Burkina Faso and Cote d'Ivoire. All "illegal" movements of live poultry and poultry products from the two neighbouring countries were closely monitored and such birds were confiscated and destroyed with the cooperation of the Customs Excise and Preventive Service (CEPS) and the Ghana Police Service. At all the approved entry points from the two countries, the VSD carried out disinfection of all vehicles and passengers had to walk through foot baths.

Burkina Faso and Cote D'Ivoire share common borders with the three regions of the North (Upper East, Upper West and Northern Regions). Taking account of the active movement of live poultry and people, a workshop was organized for all veterinary personnel of the three regions to enable them to create the necessary awareness to prevent AI introduction into Ghana through the three regions of the North.

In Ghana the first outbreak was recorded in 2007. On April 24th 2007, the VSD using the rapid test kit for influenza type A viruses detected potential AI H5 virus infection on a small scale poultry farm located at Kakasunanka within the Tema Metropolitan area of the Greater Accra Region. On 26th April 2007, the Emergency Preparedness Team of VSD destroyed the in-contact birds of the infected poultry house on site. Further tests at the Accra Veterinary Investigation laboratory using HA/HI on 28th April 2007 indicated H5N1. Tests at the Noguchi Memorial Institute for Medical Research (NMIMR), Legon confirmed the presence of the disease. Bans were placed on the movement of poultry and poultry products in the outbreak area. Samples were sent to the International Reference Laboratory for Newcastle Disease and Avian Influenza at Instituto Zooprofilattico Sperimentalle delle Venezie, Padova, Italy and the United States Naval Medical Research Unit-3, Cairo, Egypt which were confirmed as positive. The VSD Emergency Preparedness Team on 29th April 2007 destroyed all

poultry in the focus of the outbreak, resulting in the culling of 1944 poultry including 4 ducks. An active search for AI in the Tema area started on 30th April 2007. A total of 64 farms were inspected and sampled for the detection of the presence of the AI virus. By 3rd May 2007, positive cases were detected on 3 farms at Adjei Kojo, a suburb of Tema. These were Letap farms, Coker-Appiah's farms and Robert's Farms. A total of 21622 birds were destroyed on the affected farms. Other cases were detected at Nungua Farms in the Tema Metropolis on 27th May 2007. A total of 7999 birds were destroyed on the farms by 29th May 2007. All poultry within a 3km radius were destroyed and quarantine restrictions placed on all farms in these areas. The culling zone was extended to 5km and then 8km. The sale and movement of poultry and poultry products in the Tema Metropolitan Area was banned.

Another outbreak was detected on the farm of a backyard poultry farmer at Asuokwa, New Dormaa in Sunyani in the Brong Ahafo Region on 15th May 2007. Rapid test, HA/Hi tests and Reverse Transcript-PCR (RT-PCR) done at NMIMR were positive for H5N1. An active search (including sampling) of all poultry farms within the area revealed only one positive farm. A total of 2629 birds including local fowls and other poultry in the culling area were destroyed. Also, eggs and feed present on the affected premises were destroyed.

The 3rd outbreak occurred at Aflao, in the Ketu District of the Volta Region on the 13th June 2007. Rapid test, HA/Hi tests and Reverse Transcript-PCR (RT-PCR) done at NMIMR were all positive for H5N1. A total of 1357 birds, together with eggs and feed present on the premises were destroyed. Birds in the culling zone were also destroyed.

The Minister of Food and Agriculture during the outbreak declared the Tema Metropolis, Sunyani Municipality and Aflao in the Ketu District as infected zones according to the Diseases of Animal Act, 1961, Act 83. The measures instituted by MOFA included a ban on the movement of poultry and poultry products in and out of the infected area, closure of wet poultry markets in the area, quarantine of the infected farms, active search for the disease in the area and beyond and disinfection of infected premises and farm machinery and equipment.

The source of infection of AI in Ghana has still not been traced. According to VSD, (2007) there is close resemblance (96%) between the virus circulating in Ghana and other AI viruses causing outbreaks in the West African region. The virus strain in Ghana is said to be between 98.8 and 99.6% similar to other isolates from Cote d'Ivoire, Burkina Faso, Nigeria and Sudan (Marbett, 2007).

According to VSD (2007), since the last outbreak in June 2007, no case or report of unusual deaths (high mortalities) in poultry had been reported from anywhere in Ghana.

The following culled from a document produced by VSD (2007) gives an overview of risk analysis for HPAI in Ghana. *"Ghana borders Togo to the east, Burkina Faso to the north and Cote d'Ivoire to the west. All these four countries have recorded outbreaks of the HPAI H5N1 virus in their respective countries, starting in April 2006 in Burkina Faso and Cote d'Ivoire and in April 2007 and June 2007 in Ghana and Togo, respectively. There are approved entry points between the countries and there exists a very high level of movement of both goods, including live animals and animal products, and people of the four countries. There are also unapproved routes, involving the illegal movement of animals and animal products across the sub-region. These unapproved routes can act as channels for the introduction of trans-boundary animal diseases into any of the four countries.*

Uncontrolled movement of live poultry and poultry products across the borders poses a serious threat to the animal health, especially avian influenza, of any of the countries in the sub-region. Due to the artificial boundaries and the mix of socio-cultural ties of citizens of these countries, it is always very difficult to enforce quarantine measures in the event of outbreaks of trans-boundary animal diseases in any of the above countries.

Within the country, the uncontrolled entry of new poultry farmers into the poultry sector, especially those of sector 3 engaged in commercial layer (egg production) and very little broiler production, with no adequate knowledge of basic standard operating procedures of the poultry industry creates a threat to animal and human health safety. Sometimes due to a high incidence of theft, such owners erect poultry structures in their own houses, whilst housing free roaming local birds as well.

Producers of poultry products (eggs and spent layers) of the sector 3 poultry farms sell their products to any buyer, who moves from one farm to another, sometimes in a hired vehicle, in search of poultry products to buy. Bio-security on such farms is virtually nonexistent. This definitely is a very serious risk and oftentimes leads to the introduction of infection onto a healthy farm.

In Ghana, some farmers raise cockerels and pullets (to brooding age of about 4-6 weeks) and sell them to itinerant traders, who carry them on their heads and move all over the place selling to small holders (local fowl owners) for upgrading (crossbreeding) of their local stock. Sometimes these birds could be picked from an infected farm and through their movement the infection could be spread over a wider geographic area, especially to the local poultry population. This could create, in the event of an uncontrolled outbreak of the highly pathogenic avian influenza virus, an explosion in the local poultry population, which could therefore result in an endemic situation.

Ghana also has so many wetlands and other water bodies that can attract migratory birds. However, the role of migratory birds in the epidemiology of the avian influenza in this part of the world is not very strong, even though Ghana lies in the path of two major flyways of migratory wild birds. It should nonetheless never be ruled out and efforts should also be made at testing for HPAI viruses (through active surveillance) in the wild birds at the staging sites/water bodies in the country. Considering the above identified risks factors, Ghana could be classified as a medium risk country as regards the establishment of endemicity of avian influenza."

With the outbreak in Benin in December 2007, there was a continuum of affected countries along the West African coast from Cote d'Ivoire to Cameroon. In all, 8 countries in West Africa have recorded HPAI H5N1 (Nigeria, Niger, Cameroon, Burkina Faso, Cote d'Ivoire, Ghana, Togo and Benin). These pose a danger for circulation of the virus as these countries are members of ECOWAS and there is constant movement of people and goods and trade between them. Akunzule (2006) noted that "infected material from these infected West African countries could be introduced into Ghana through approved and unapproved routes, village routes, and trade and human movements."

The Director, Federal Ministry of Agriculture and Rural Development of Nigeria on 24th July 2008 reported of AI outbreaks at Kebbi (involving a local chicken sampled during routine surveillance of live bird markets) and at Gombe (a single duck sampled during routine surveillance exercise at live bird markets) on 19th July 2008. Samples were confirmed positive by HI, RT-PCR and virus isolation tests. These go to emphasise the danger of transmission of the virus for recurrence in the sub-region.

Eight (8) West African countries (Nigeria, Niger, Cameroon, Burkina Faso, Cote d'Ivoire, Ghana, Togo and Benin) have all reported outbreaks. Benin, Nigeria and Togo reported new outbreaks on 1 May 2008, 25 July 2008 and 13 November 2008, respectively (OIE, 2008). The risk of virus circulation and re-infection/re-introduction is high in the sub-region. Recently, a new virus strain not earlier associated with outbreaks in Nigeria was isolated in Nigeria raising more concerns in the sub-region.

A background paper on HPAI in Ghana funded by DFID was prepared in 2008 as part of a collaborative research on pro-poor HPAI risk reduction in Ghana, Nigeria, Kenya, Ethiopia, Indonesia, Thailand and Vietnam from which the information given above was taken. As a follow-up a Risk pathway workshop was held in Accra, Ghana from 25-26 November 2008 involving major stakeholders from VSD, Poultry Farmers Associations, Universities, and a private veterinary practitioner (Annex 1).

The stakeholders identified a number of risk questions (Annex 2) out of which they agreed on conducting a risk assessment on re-introduction of the HPAI virus.

1.2 Approach

This risk assessment (RA) follows the OIE framework. This can be summarised as assessing risk of release, exposure, consequences and overall risk estimation (OIE 2004). It, however, considered the release assessment aspect as emphasised by VSD.

The risk assessment will, taking into account the most recent scientific evidence and epidemiological information, address in particular the risk of re-introduction of HPAI H5N1 from neighbouring countries (Burkina Faso, Cote d'Ivoire and Togo) into Ghana via cross-border trade involving live birds, poultry products and fomites.

The emphasis was placed on risk of re-introduction (release) because that is what the participants at the workshop agreed was of paramount concern. The Veterinary Services Directorate is confident of dealing with the exposure and consequence within the country because it has mitigation processes and procedures in place as a result of the outbreaks in 2007. These outbreaks were believed to have been introduced from a neighbouring country. The desire, therefore, is to prevent the re-introduction of the virus into the country and this was made evidently clear at the workshop. This has advised the choice of the release assessment rather than exposure and consequence assessment.

This risk assessment was conducted as a qualitative assessment, since a quantitative approach would have required detailed epidemiological information which is currently not available for this disease in the countries involved.

Within the qualitative risk assessment, probabilities are assessed and described textually on a scale from negligible through to very high (see Table 1.1).

Table 1.1: Interpretation of probability categories used in this risk assessment (EFSA, 2006)

Probability category	Interpretation
Negligible	Event is so rare that does not merit to be considered
Very low	Event is very rare but cannot be excluded
Low	Event is rare but does occur
Medium	Event occurs regularly
High	Event occurs very often
Very high	Even occurs almost at certainly

Adapted from: The EFSA journal. 2006. Migratory birds and their possible role in the spread of highly pathogenic avian influenza. 155p.

In addition, the level of uncertainty was associated to each risk estimate. Levels of uncertainty are presented in Table 1.2. . In the context of this qualitative risk assessment variability and uncertainty were both captured by the uncertainty level.

Table 1.2: Qualitative categories for expressing uncertainty in relation to qualitative risk estimates (EFSA, 2006):

Uncertainty category	Interpretation
Low	Solid and complete data available; strong evidence provided in multiple references; authors report similar conclusions
Medium	Some but no complete data available; evidence provided in small number of references; authors report conclusions that vary from one another
High	Scarce or no data available; evidence is not provided in references but rather in unpublished reports, based on observations, or personal communication; authors report conclusions that vary considerably between them

Adapted from: The EFSA Journal. 2006. Migratory birds and their possible role in the spread of highly pathogenic avian influenza. 155p.

For each country of origin (Cote d'Ivoire, Burkina Faso and Togo), qualitative risk estimates were combined for each identified risk pathways using the combination matrix in Table 1.3.

Table 1.3: Combination matrix used to combine qualitative risk estimates.

		Parameter 2					
Parameter 1		Negligible	Very Low	Low	Medium	High	Very High
	Very High	N	VL	L	M	H	VH
	High	N	VL	L	M	H	H
	Medium	N	VL	VL	L	M	M
	Low	N	N	VL	VL	L	L
	Very Low	N	N	VL	VL	VL	VL
	Negligible	N	N	N	N	N	N

Adapted from: Cristobal Zepeda (Centers for Epidemiology and Animal Health USDA-APHIS/ Animal Population Health Institute, Colorado State University) with slight modifications.

Period of Assessment

The assessment was done between November 2008 and March 2009. During this period there was no reported outbreak of HPAI H5N1 in Ghana, Cote d'Ivoire or Burkina Faso. Togo, however reported an outbreak in November 2008 which was contained.

Timeframe of the risk assessment

The timeframe considered for this release assessment was the year 2007. When data were not available for 2007, the year used as reference was specified.

2. Risk question

The risk questions were formulated on the basis of the conclusions of the stakeholders' meeting held on 25-26 November 2008 in Accra and were as specific as possible in order to focus the efforts of the Risk Assessment Team.

The following risk questions were defined:

2.1 Risk question 1: Release assessment

What is the risk of re-introduction of HPAI H5N1 **virus from neighbouring countries (Burkina Faso, Côte d'Ivoire and Togo) into Ghana via cross-border trade and movements involving people, live birds, poultry products and fomites?**

2.2 Risk question 2: Exposure and Consequence assessment

What is the risk of transmission of H5N1 within small scale commercial farms involving live birds, poultry products and fomites?

The risk assessment done in this report addresses only the risk of release. The exposure and consequence assessment was not done. The emphasis was placed on risk of re-introduction (release) because that is what the participants at the workshop agreed was of paramount concern. The Veterinary Services Directorate is confident of dealing with the exposure within the country because it has mitigation processes and procedures in place as a result of the outbreaks in 2007.

3. Risk pathways

3.1 Overview

The risk pathways involving various commodities in each of the 3 neighbouring countries were identified. In this report only release pathways were of interest. The release pathways as identified and constructed by the participants are shown in Annex 3. Scenario trees for the 3 countries developed from the risk pathways are presented below in Figures 3.1-3.3.

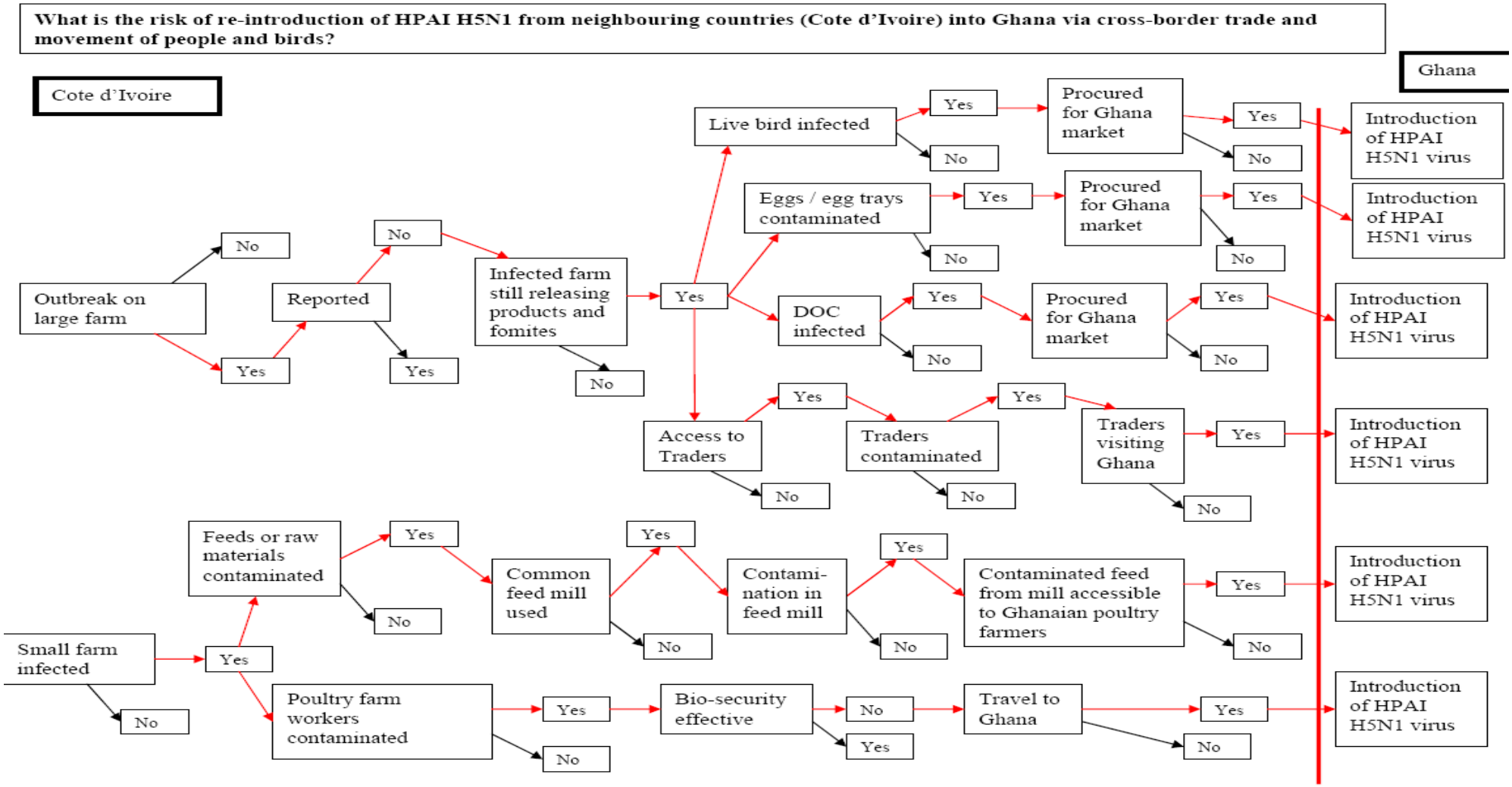

Figure 3.1: Scenario tree for risk pathway originating from Côte d'Ivoire

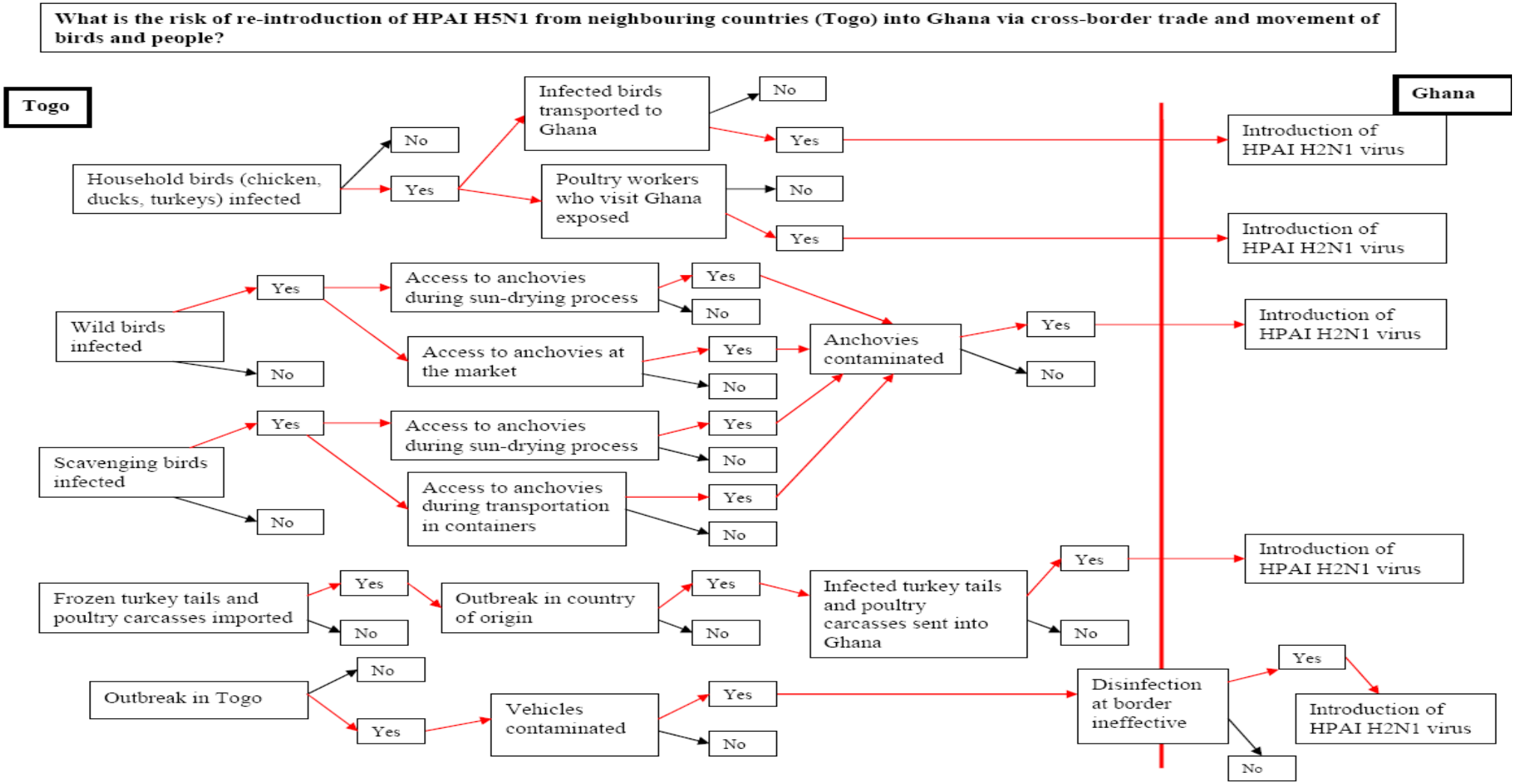

Figure 3.2: Scenario tree for risk pathway originating from Togo

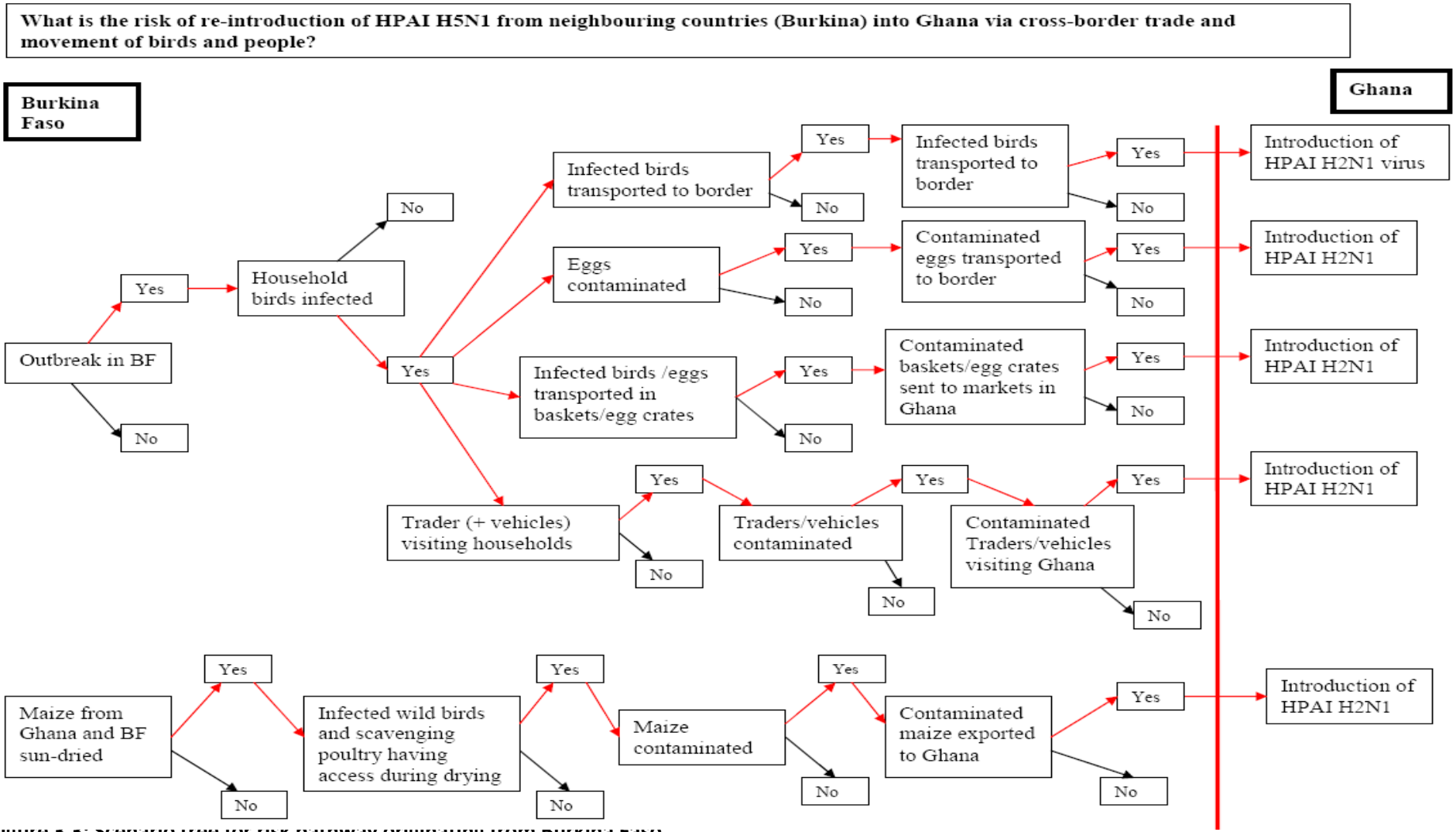

Figure 3.3: Scenario tree for risk pathway originating from Burkina Faso

For the 3 countries, the major concerns during discussions were the informal or illegal trade in poultry and poultry products coming into Ghana through unapproved entry points which cannot be controlled or monitored effectively. It was noted that with the policy of ban on importation of poultry and poultry products from countries that had had outbreaks, officially no poultry or poultry products from the neighbouring countries were to come into Ghana so whatever were coming in were illegal.

In Burkina Faso, the major source was identified as contaminated baskets used in carrying guinea fowls and which had capacity of up to 50 birds per container. These are often reused but cannot be disinfected because they are made of millet straws or materials that cannot withstand disinfection.

From Togo, the major concern was the importation of turkey tails and some poultry products which were officially banned but were available on Ghanaian markets through unapproved routes. Also, the close family ties within the communities living along the border presented peculiar challenges to controlling movement of poultry and poultry products and poultry on free range traversed the border back and forth easily.

For Côte d'Ivoire, the existence and operation of farms on both sides of the border by families from Ghana and Cote d'Ivoire (for example, Unity Farms at Dormaa Ahenkro in Ghana with a brother's farm in Cote d'Ivoire) allowing movement of eggs, feed, day old chicks etc posed as risks for introduction or re-introduction of HPAI H5N1. It was alleged during discussions that despite a ban on importation of poultry and poultry products from Cote d'Ivoire, eggs were carted to border towns and loaded onto Inter-city buses on the Ghana side to be transported to various destinations in Ghana which present a threat to the introduction and spread of the virus in case of an outbreak.

It was clear from the discussions that the use of unapproved routes for the entry of poultry, poultry products and movement of people into Ghana from the neighbouring countries posed a real and present risk for re-introduction of HPAI H5N1 virus into Ghana. A list of approved and known unapproved entry points and sectors of the Ghana Immigration services is given in Annex 5.

3.2 Exposure pathways

Although the paramount interest of the participants was on release pathways, exposure pathways were developed by the Risk Assessment Facilitator and are presented below. The exposure assessments for these pathways were not developed further as they were beyond the scope of the present assessment.

Exposure pathways within Ghana after re-introduction of HPAI H5N1 from neighbouring country (Cote d'Ivoire) into Ghana via cross-border trade and movement of birds and people.

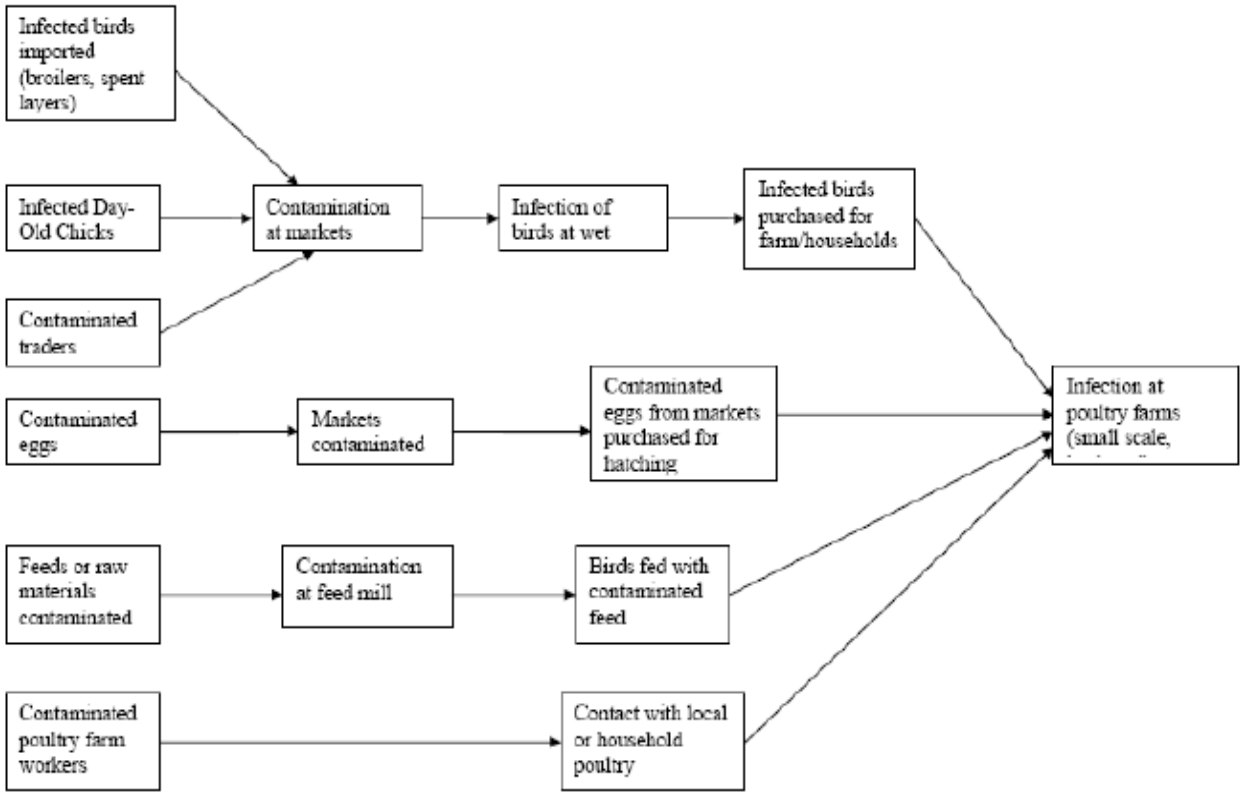

Figure 3.4: Exposure pathway for risks from Cote d'Ivoire

Exposure pathways within Ghana after re-introduction of HPAI H5N1 from neighbouring country (Burkina) into Ghana via cross-border trade and movement of birds and people.

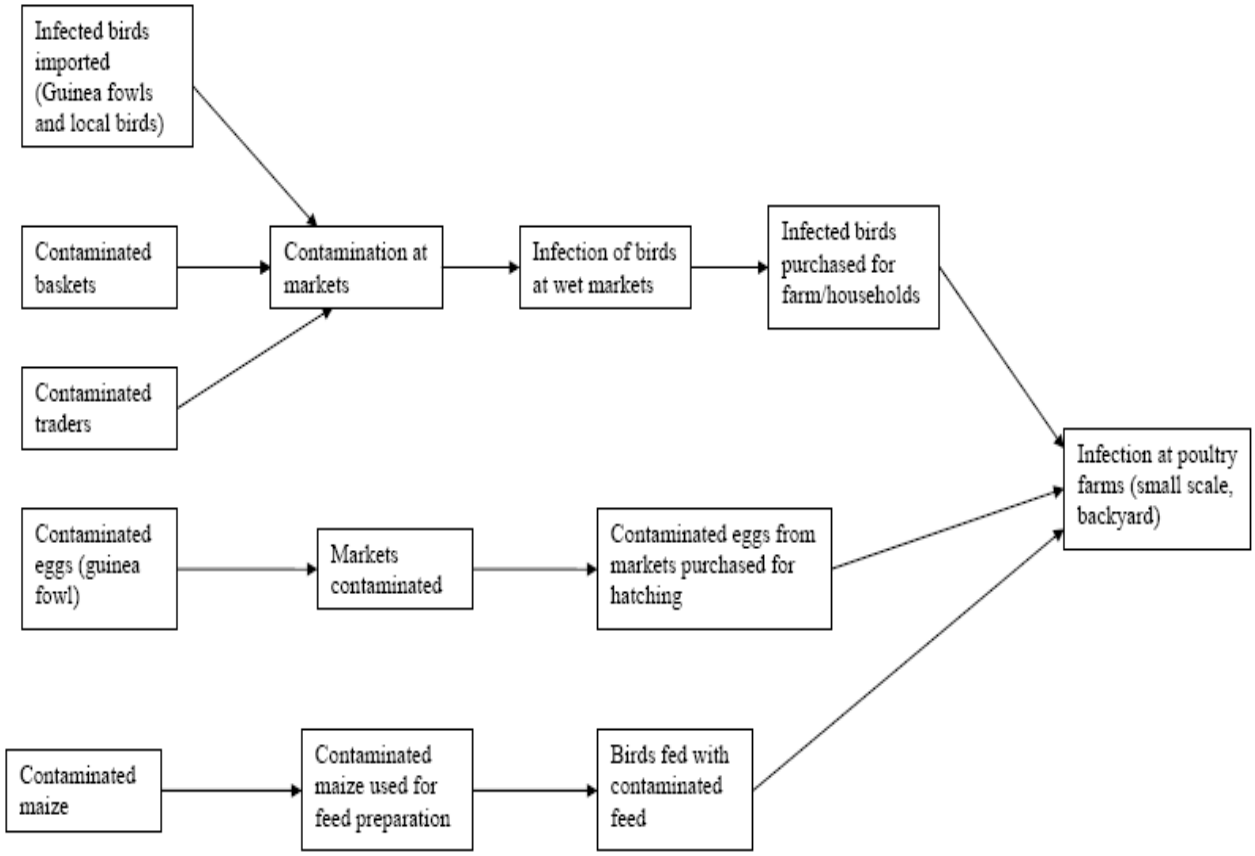

Figure 3.5: Exposure pathway for risks from Burkina Faso

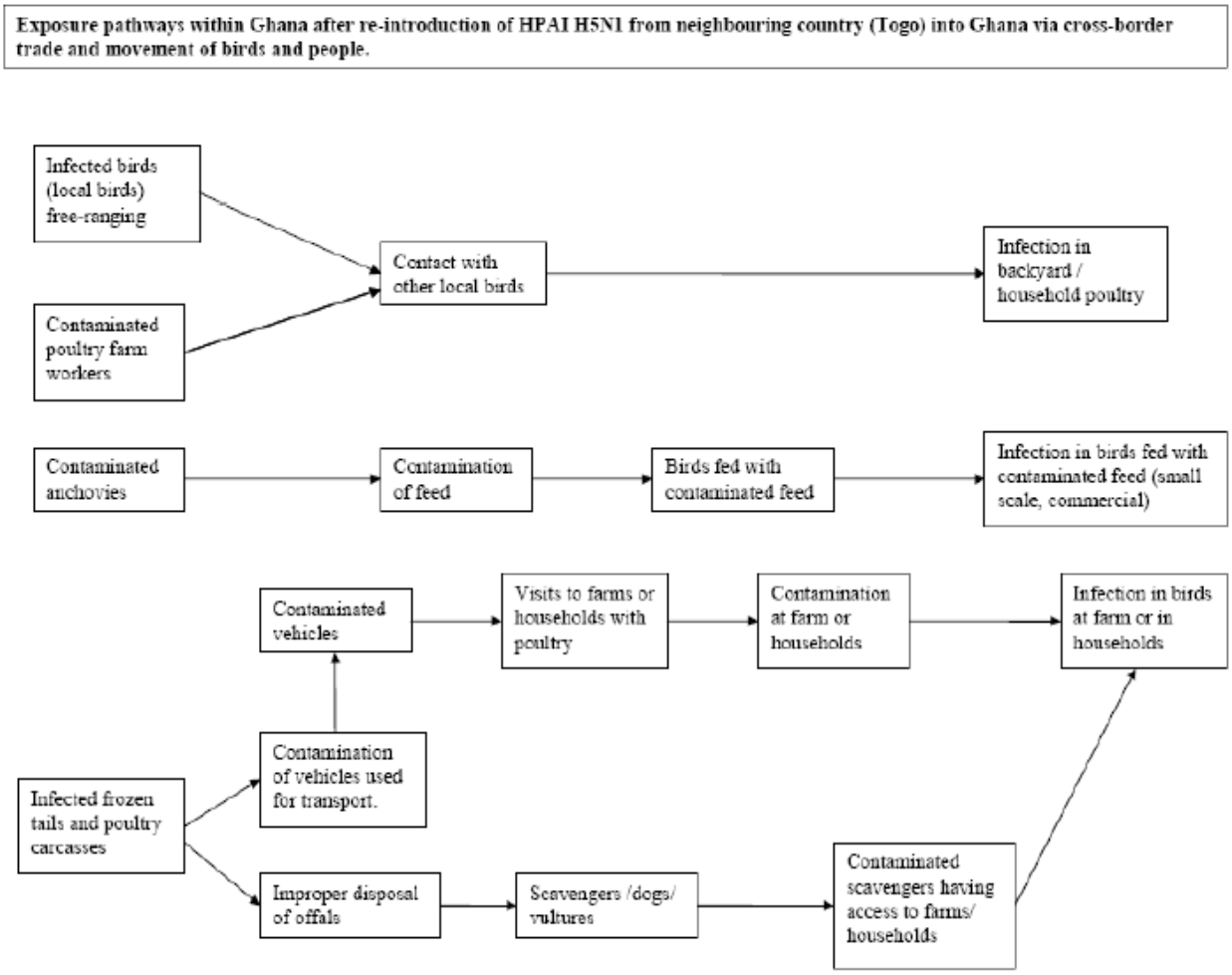

Figure 3.6: Exposure pathway for risks from Togo

4. Risk Assessment for Release

4.1 Pathway I: Re-introduction of HPAI virus into Ghana from Cote d'Ivoire

Overview of information required for pathway I

The data needs and information sources for release pathway I involving risks from Cote d'Ivoire are presented in Table 4.1.

Table 4.1: Data needs and information sources for Côte d'Ivoire (CI) Risk pathway

Step of risk pathway	Data needs	Data source
Risk of infection on farms in CI	Prevalence Location Outbreak data	OIE - WAHIS
Risk of an infected large farm still releasing products	Surveillance and control measures (Vaccination procedures etc)	Country reports at CVO meeting (Contacting CVO)
Risk of live bird infected given the farm is infected	Prevalence	OIE-WAHIS
Risk of introduction of infected live bird from CI into Ghana	Species of birds Volume of birds Points of entry Origin	Value chain analysis (VCA) from FAO (Identify gaps for DfID VCA) Ghana Immigration Service CVO Ghana
Risk of contamination of eggs and egg trays	Volume of eggs Points of entry Virus survival Origin	VCA from FAO (Identify gaps for DfID) Ghana Immigration Service Published literature CVO Ghana
Risk of infection of day old chicks (DOC)	Volume Points of entry Origin of DOC / parent stock	VCA from FAO Ghana Immigration Service VCA from FAO
Risk of contamination of feeds or raw materials	Volume Type of feeds or raw materials Virus survival Previous outbreak data for small farms	Ministry of Trade / MOFA Customs Published literature OIE-WAHIS
Risk of contamination of feeds and raw materials at feed mills	Number of farms using the same feed mill	Poultry association
Risk of contamination of traders	Frequency of farm visits - Eggs traders - Spent layer traders	Poultry association
Risk of contamination of poultry farm workers.	Frequency of PFW visiting Ghana Points of entry Level of bio-security	Poultry association Ghana Immigration Service Poultry association

Data Collection

A questionnaire covering the data needs for risk assessment (see Annex 4) was developed by the Risk Assessment Facilitator. It was translated into French by the Activity Leader (Raphaëlle Métras). The questionnaire for Cote d'Ivoire was sent by email to the Chief Veterinary Officer (Dr Kanga Kouame) on 10th February 2009. No response was received up to middle of March 2009 despite reminders. Another veterinarian, Dr Louis Ketremindie was approached who responded and sent a completed questionnaire on 20th March 2009. Other people/institutions in Ghana were contacted to respond to the questionnaire. They were:

- The Acting Director of Veterinary Services, Ghana (Dr E M B Koney)
- Dr A Akunzule, a veterinarian and founder, Ghana Poultry Network, Ghana

- Dr F Konadu Ampratwum, a deputy director of Veterinary Services in charge of public health and a member of the AIWG.
- Greater Accra Poultry Farmers Association (represented by Mr Seth Wilson)
- Oyarifa Livestock Farmers Association (represented by Mr John Torto)
- TIG Farms (Through the Value Chain Analysis facilitated by Dr A Mensah-Bonsu)
- Unity Farms (Through the Value Chain Analysis facilitated by Dr A Mensah-Bonsu)
- Statistical Research and Information Directorate of MOFA, Accra Ghana
- Livestock Planning and Information Unit of MOFA, Ghana

The responses from Dr Ketremindie, TIG farms and Unity Farms were very informative and were used for the assessment. The other sources reported that they had no idea for most of the questions.

Attempts were made for supplementary data through extensive electronic literature search. Grey literature was also obtained from sources within Ghana to complement the literature search.

Information on approved and known unapproved entry routes into Ghana (Annex 5) was obtained from the Ghana Immigration Services.

4.2 Pathway 1 CI: Re-introduction via infected live birds

Probability of infection on farms in CI

Description of information available

The poultry population in Cote d'Ivoire in 2007 was estimated to be about 30 million birds (Dr Ketremindie). The proportion of poultry farms in 2007 described as large farms (10,000-20,000 birds) was about 30%. None of the large farms experienced an outbreak in 2006 in Cote d'Ivoire. The prevalence of HPAI within large farms was likely 0%. The large farms are located in the South, Central-West East and North Eastern parts of CI with 60% of these being within 100km of the border with Ghana. Other proportions for large farms located within 100km of the border with Ghana were 20% (VCA Unity farms) and 60% (VCA TIG farms).

Interpretation

The probability of infection on large farms in CI was estimated to be negligible (medium uncertainty) because there were no outbreaks on these farms in 2006, neither were there any reports in 2007.

Probability of an infected large farm still releasing products

Description of information available

During the outbreak in 2006 Cote d'Ivoire (CI) set up surveillance and control measures that have been implemented since then and might reduce the probability of releasing infected products. No reports of outbreaks have been made since 2006. There is information that some vaccinations were done on some farms in CI. Reports to OIE (2006) indicate that vaccination was done in response to outbreaks with 114,803 birds (made up of 9,011 birds in the traditional system and 105,792 birds in the modern system in Abidjan) vaccinated. There is no information that it continued into 2007. It has

been argued that vaccination might mask the presence of the virus and could lead to shedding of the virus. Vaccinations were done on limited basis in CI and were monitored to ensure that they did not present any problems of shedding of the virus thereby limiting the risk. It is reported that although HPAI typically causes death within a few days in an individual bird it may take up to two weeks for an outbreak to be seen at a large poultry farm after a single introduction (Doyle et al., 2007). This is because if the detection rule is 50 dead birds on 2 consecutive days in a 10,000 chicken flock (which was the Dutch monitoring rule for notification) was followed, then an estimate of 12 days would pass following the introduction of one sick bird before an AI outbreak was reported (Boss et al., 2007). In effect, during the first 2 weeks following introduction of HPAI on a large farm, the farm might release infected or contaminated products.

Interpretation

The probability of infected large farm still releasing products was estimated to be low (medium uncertainty.) It is possible for farms to release products during the incubation period during infection on a farm before an outbreak is detected.

Probability that live birds are infected given the farm is infected

Description of information available

There is no information on the prevalence in birds in CI. According to Kasemsuwan et al. (2008) the oral-fecal route via drinking water is a major route of infection for poultry within cages or houses. This can lead to spread to live birds on introduction of the virus onto a farm.

Interpretation

The probability of live birds being infected given a farm is infected is very high (medium uncertainty). This is because the virus is shed by those infected and may be picked up by others.

Probability of introduction of live birds from large farms in CI to Ghana market

Description of information available

There is no information on the volume and species of birds exported from CI to Ghana in 2007. However, it is estimated that about 5% of the live birds produced in CI find their way into Ghana through the East and North-East parts of CI (Dr Ketremindie). These are likely to come from large farms. It was noted that there is an official ban on import of poultry and poultry products from CI into Ghana so any birds coming into Ghana were smuggled through unapproved routes (VSD and VCA TIG Farms). Some of the entry points of live birds were identified as Kodjokrom, Yawkrom and Badukrom (Dormaa) (VCA Unity Farms).

Interpretation

The probability of introduction of live birds into Ghana was estimated to be medium (high uncertainty) because birds from CI are known to available on Ghanaian markets despite a ban on their importation.

Summary

Table 4.2 Summary for CI risk pathway 1

Step of pathway	Information obtained	Source	Risk Category	Uncertainty
Probability of infection on large farm in CI	Poultry population % Large farms Prevalence on large farms Location of large farms % of large farms producing live birds, eggs or DOC	Dr Ketremindie Dr Ketremindie Dr Ketremindie Dr Ketremindie/ VCA Unity Farm/ VCA TIG Farm Dr Ketremindie/ VCA Unity Farm/ VCA TIG Farm	Negligible	Medium
Probability of an infected large farm still releasing products	Vaccination in CI	OIE-WAHIS	Low	Medium
Probability that live birds are infected given the farm is infected	Prevalence	OIE-WAHIS	Very high	Low
Probability of introduction of live birds from large farms in CI to Ghana market	Volume of birds exported Entry points	Dr Ketremindie Unity Farms	Medium	High

Overall risk estimate and conclusion for CI pathway 1

The risk estimate for pathway 1 was calculated by combining the risk categories summarized in table 4.2, using the combination matrix presented in the approach. The pathway is made up of four parameters. The risk estimate for parameter 1 is negligible; parameter 2 is low; parameter 3 is high and parameter 4 is medium. On combining negligible X low = negligible; negligible x high = negligible; negligible x medium = negligible. As a result, the risk of re-introduction of HPAI via infected live birds from CI is negligible, with high uncertainty.

The step of CI pathway 1 associated with the higher risk category was the probability of live birds being infected given that a farm is infected.

4.3 Pathway 2 CI: Re-introduction via contaminated eggs / egg trays

Probability of an infection on large farm in CI

See information for section 42.1

Probability of an infected large farm still releasing products

See information for section 4.2.2

Probability of contamination of eggs and egg trays given a farm is infected

Description of information available

It is reported that an LPAI virus (H13N7) survived for at least three days on egg shell and plastic but was not detectable on card board egg trays or cotton or polyester fabric at two days (Doyle et al.

2007). Also, HPAI viruses have been detected on the outside surface of eggs possibly as a result of faecal contamination (Swayne and Beck, 2004). Despite these, the probability of HPAI surviving on egg shells has been given as low (Songserm 2008, cited by Kasemsuwan et al., 2008).

Interpretation

The probability of contamination of eggs and egg trays was estimated to be high (medium uncertainty). This is because if birds are infected, their faeces are likely to have the virus resulting in contamination of eggs and egg shells with subsequent contamination of egg trays.

Probability of introduction of eggs /egg trays to Ghana market

Description of information available

There is no information on the volume of eggs exported from CI to Ghana in 2007. It is estimated that about 5% of the eggs produced in CI find their way into Ghana through the East and North-Eastern parts of CI (Dr Ketremindie). It was estimated that about 7000 crates of eggs came to Ghana a week from CI (VCA Unity farms) through mainly Gonokrom (main border) and then Kodjokrom, Yawkrom and Badukrom (Dormaa) (VCA TIG Farms).

Interpretation

The probability of introducing eggs/ egg trays to Ghana market was estimated to be high (medium uncertainty) because despite a ban on importation eggs from CI are available on Ghana market though illegal smuggling.

Summary

Table 4.3 Summary for CI risk pathway 2

Step of pathway	Information obtained	Source	Risk Category	Uncertainty
Probability of infection on large farm in CI	Poultry population % Large farms Prevalence on large farms Location of large farms % of large farms producing live birds, eggs or DOC	Dr Ketremindie Dr Ketremindie Dr Ketremindie Dr Ketremindie/ VCA Unity Farm/ VCA TIG Farm Dr Ketremindie/ VCA Unity Farm/ VCA TIG Farm	Negligible	Medium
Probability of an infected large farm still releasing products	Vaccination in CI	OIE-WAHIS	Low	High
Probability of contamination of eggs and egg trays given the farm is infected	Virus survival	Kasemsuwan et al. 2008	High	Medium
Probability of introduction of eggs / egg trays to Ghana market	Volume of eggs Entry points	Dr Ketremindie/ VCA Unity Farm VCA TIG Farm	High	Medium

Overall risk estimate and conclusion for pathway 2

The risk estimate for pathway 2 was calculated by combining the risk categories summarized in Table 4.3, using the combination matrix presented in the approach. There were 4 parameters/steps in the pathway with the following risk estimates: negligible, low, high and high, respectively. On combining, negligible X low= negligible; negligible X high = negligible. Therefore, the risk of re-introduction of HPAI via eggs / egg trays from CI is negligible, with high uncertainty.

The steps of pathway 2 associated with the higher risk category were the probability of contamination of eggs/egg trays given the farm is infected and by the probability of introduction of eggs & egg trays from CI to Ghana market.

4.4 Pathway 3 CI: Re-introduction via infected DOC

Probability of an infection on large farm in CI

See information for section 4.2.1

Probability of an infected large farm still releasing products

See information for section 4.2.2

Probability of infection of day old chicks (DOC), given a farm is infected.

Description of information available

The DOCs were said to have probably originated from FOANI Services and another farm in Agnebrekrom in CI (VCA TIG Farms; VCA Unity Farms). There were no outbreaks reported on these farms.

Interpretation

The probability of infection of day old chicks was estimated to be very low (medium uncertainty) because there have been no outbreaks reported from such farms.

Probability of introduction of DOC to Ghana market

Description of information available

There is no information on the volume of DOC exported from CI to Ghana in 2007. However, it is estimated that about 0.1% of the DOC produced in CI find their way into Ghana through the East and North East parts of CI (Dr Ketremindie). About 0.2% of large farms produce DOC (Dr. Ketremindie). The parent stock of the DOC originated from Europe. It was estimated that 900,000 DOCs were exported from CI to Ghana in 2007 (VCA Unity Farms) and entered Ghana through mainly Gonokrom (main border) and then Kodjokrom, Yawkrom and Badukrom (Dormaa) (VCA TIG Farms) for onward transmission to Dormaa Ahenkro, Sunyani, Berekum and Kumasi (VCA Unity Farms).

Interpretation

The probability of introduction of day old chicks was estimated to be high (medium uncertainty) because despite a ban on importation DOCs from CI are available on Ghana market though illegal smuggling.

Summary

Table 4.4: Summary for CI risk pathway 3

Step of pathway	Information obtained	Source	Risk Category	Uncertainty
Probability of infection on large farm in CI	Poultry population % Large farms Prevalence on large farms Location of large farms % of large farms producing live birds, eggs or DOC	Dr Ketremindie Dr Ketremindie Dr Ketremindie Dr Ketremindie/ VCA Unity Farm/ VCA TIG Farm Dr Ketremindie/ VCA Unity Farm/ VCA TIG Farm	Negligible	Medium
Probability of an infected large farm still releasing products	Vaccination in CI	OIE-WAHIS	Low	High
Probability of infection of DOC given the farm is infected	Prevalence on large farms	Dr Ketremindie	Low	Medium
Probability of introduction of DOC to Ghana market	Volume of DOC Entry points	Dr Ketremindie/ VCA Unity Farm VCA TIG Farm	High	Medium

Overall risk estimate and conclusion for pathway 3

The risk estimate for pathway 3 was calculated by combining the risk categories summarized in table 4.4, using the combination matrix presented in the approach. The pathway had 4 parameters/steps with the risk estimate for the first parameter being negligible. On combination, negligible X low= negligible; negligible X high = negligible. The risk of re-introduction of HPAI via DOC from CI is therefore, negligible, with high uncertainty.

The step of pathway 3 associated with the higher risk category was the probability of introduction of DOC from CI to Ghana market.

4.5 Pathway 4 CI: Re-introduction via contaminated traders

Probability of an infection on large farm in CI

See information for section 4.2.1

Probability of an infected large farm still releasing products

See information for section 4.2.2

Probability of contamination of traders

Description of information available

Humans are potential mechanical vectors for introduction of HPAI virus, and certain professions associated with poultry production are considered as the highest risk population (Kasemsuwan et al. 2008), especially the traders who visit farms to obtain live birds or eggs. Traders were considered by the workshop participants as the highest risk population because they moved from farm to farm and then from market to market. However, there was no information on frequency of farm visits by egg or spent layer traders.

Interpretation

The probability of contamination of traders was estimated to be medium (high uncertainty) because the virus is shed by infected birds and humans may become contaminated when they come into contact with the shed virus.

Probability of traders visiting Ghana

Description of information available

There is no information on the number of egg traders in CI in 2007. There are many middlemen, confounding the situation (VCA TIG Farms). There were about 800,000 spent layer traders in 2007 (Dr Ketremindie).

There is no information on the proportion of egg or spent layer traders who visited Ghana in a month in 2007. It was argued that “unofficially some of the egg traders visit Ghana a lot due to the [use] of unapproved routes” (VCA TIG Farms). The proportion of spent layer traders in CI visiting Ghana in 2007 in a month was given as 0% (VCA Unity Farms).

Interpretation

The probability of egg and spent layer traders visiting Ghana was estimated to be very low (high uncertainty). This is because the traders need not enter the country themselves to transact business but can send the products unaccompanied.

Summary

Table 4.5: Summary for CI risk pathway 4

Step of pathway	Information obtained	Source	Risk Category	Uncertainty
Probability of infection on large farm in CI	Poultry population % Large farms Prevalence on large farms Location of large farms % of large farms producing live birds, eggs or DOC	Dr Ketremindie Dr Ketremindie Dr Ketremindie Dr Ketremindie/ VCA Unity Farm/ VCA TIG Farm Dr Ketremindie/ VCA Unity Farm/ VCA TIG Farm	Negligible	Medium
Probability of an infected large farm still releasing products	Vaccination in CI	OIE-WAHIS	Low	High
Probability of contamination of traders	Humans as vectors	Kasemsuwan et al. 2008	Medium	High
Probability of contaminated traders visiting Ghana	Proportion of traders visiting Ghana	VCA Unity Farm/ VCA TIG Farm	Very low	High

Overall risk estimate and conclusion for pathway 3

The risk estimate for pathway 4 was calculated by combining the risk categories summarized in Table 4.5, using the combination matrix presented in the approach. The pathway had 4 parameters/steps. Parameter 1 was estimated as negligible risk, parameter 2 low, parameter 3 medium and parameter 4 very low. When combined negligible X low = negligible; negligible X medium = negligible; negligible X very low= negligible. In effect, the risk of re-introduction of HPAI via traders from CI visiting Ghana is negligible, with medium uncertainty.

The step of pathway 4 associated with the higher risk category was the probability of contamination of traders. This is because these traders when they visit infected premises may become mechanical vectors.

4.6 Pathway 5 CI: Re-introduction via contaminated feeds and raw materials

Probability of infection in wild and scavenging birds

Description of information available

There is no information on the prevalence of HPAI H5N1 virus in wild and scavenging birds. CI has wetlands that are part of the Migratory Bird flyway in Africa. OIE (2007) argued that countries with large wetlands that are destinations of wild bird migrating directly from infected countries are to be considered as being at relatively high risk of HPAI H5N1 virus incursion, especially in areas of high agricultural production and where poultry are in contact with wild birds. Outbreaks in Thailand and Japan were most frequently associated with Passerifomes birds including crows (Kasemsuwan et al. 2008). House sparrows experimentally infected with HPAI shed the largest amount of virus (Greiner et al., 2007). HPAI H5N1 virus was confirmed in a dead sparrow hawk in CI during the outbreak in 2006 (OIE-WAHIS, 2006).

Interpretation

The probability of infection in wild scavenging birds was estimated as low (high uncertainty). This is because the virus was found in a wild bird in 2006.

Probability of contamination of feeds and raw materials

Description of information available

Virus survival in wheat bran, maize, and fish meal is not known. These feedstuffs are often dried in the sun during which they may be contaminated by being exposed to infected wild or scavenging birds. However, the virus is likely to be inactivated by the solar and UV radiation. The expected inactivation of Influenza A virus by solar ultraviolet radiation has been described for many cities of the world by Sagripanti and Lytle (2007). Kasemsuwan et al. (2008) noted that in Thailand maize was heated by sunlight for at least 30 minutes at temperatures sufficiently high to inactivate the virus, but even if the maize was contaminated with faecal bird droppings, the virus would still become inactivated through the heat and UV light.

Interpretation

The probability of contamination of feeds or raw materials was estimated to be negligible (medium uncertainty) because virus survival in the feed and raw materials and in the processing of these is doubtful.

Probability of contamination of feeds and raw materials at feed mills

Description of information available

There were 10 industrial level feed mills and many small units in CI in 2007 (Dr Ketremindie). Big farms have feed mills apart from Ivoire Grain (VCA TIG Farms). Between 70% (Dr Ketremindie) and 90% (VCA TIG Farms; VCA Unity Farms) of poultry farms in CI used feed mills in 2007. There is no information on the number of farms using the same feed mill.

Interpretation

The probability of contamination at feed mills was estimated to be very low (high uncertainty).

Probability of introduction of raw materials and feeds to Ghana market

Description of information available

There is no official information on the volume, type of feed or raw materials exported from CI to Ghana in 2007. It was, however, noted that small quantities of maize, fish meal wheat bran could have been imported in 2007 (VCA TIG Farms). Another estimate was that 500 bags of wheat bran (60 kg weight) and 200 bags of maize (100 kg weight) per day came to Ghana from CI in 2007 (VCA Unity Farms).

Interpretation

The probability of introduction of feeds or raw materials to Ghana market was estimated to be very low (medium uncertainty). This is because it is only small quantities that may get into the country.

Summary

Table 4.6: Summary for CI risk pathway 5

Step of pathway	Information obtained	Source	Risk Category	Uncertainty
Probability of infection in wild and scavenging birds	Prevalence	OIE-WAHIS	Very low	High
Probability contamination of feeds and raw materials	Virus survival	Kasemsuwan et al. 2008	Negligible	High
Probability of contamination of feeds and raw materials at feed mills	Proportion of farms using feed mills	Dr Ketremindie/ VCA Unity Farm/ VCA TIG Farm	Very low	High
Probability of introduction of raw materials and feeds to Ghana market	Volume of raw materials and feeds exported Entry points	Dr Ketremindie/ VCA Unity Farm VCA TIG Farm	Very low	Medium

Overall risk estimate and conclusion for pathway 5

The risk estimate for pathway 5 was calculated by combining the risk categories summarized in Table 4.6, using the combination matrix presented in the approach. The pathway had 4 parameters. Parameters 1, 3 and 4 were estimated as having very low risk, while the risk for parameter 2 was negligible. On combining very low risk (parameter 1) with negligible risk (parameter 2), the resultant risk is negligible, which on further combinations with the risks estimates for parameters 3 and 4 remain as negligible risk. The risk of re-introduction of HPAI via raw materials and feeds is, therefore, negligible, with high uncertainty.

The steps of pathway 5 associated with the higher risk category were the three all estimated as having very low risk.

4.7 Pathway 6 CI: Re-introduction via contaminated poultry workers from small farms

Probability of an infection on small farm in CI

Description of information available

An outbreak of HPAI reported to OIE on 25th April 2006 in CI was in small scale farms and affected 890 chickens, around 100 ducks and about 10 pigeons all in a free range system. There were other outbreaks in traditional backyard systems made up of free-ranging chicken. The prevalence of HPAI H5N1 virus on small farms in CI is not known.

Interpretation

The probability of infection on a small farm in CI was estimated to be medium (medium uncertainty). This is because this was where the outbreaks in 2006 were seen.

Probability of contamination of small farm poultry workers

Description of information available

Humans are mechanical vectors and poultry workers are among the high risk populations (Kasemsuwan et al. 2008). When there is an infection on a farm the workers might become contaminated and spread the disease, if the necessary bio-security procedures and measures are not adhered to. There was no information on the bio-security levels and measures on the farms.

Interpretation

The probability of contamination of poultry workers, given an infection on a small farm is estimated to be high (medium uncertainty).

Probability of small farm poultry workers visiting Ghana

Description of information available

It is estimated that there were about 15,000 poultry farm workers in CI in 2007, with about 80% of them working on small farms (farms with 2000-5000 birds (Dr Ketremindie). Another source indicated that there were about 100,000 poultry farm workers with about 70% working on small farms (VCA Unity Farms). There is no official information about the proportion of the small poultry farm workers who visited Ghana in a month in 2007, or on the disinfection procedures and levels of bio-security on farms whose workers visited Ghana frequently. However, it was reported that about 5% of the poultry workers in CI visited Ghana in a month in 2007, entering through Kodjokrom, Yawkrom and Badukrom (Dormaa) (VCA Unity Farms).

Interpretation

The probability of small farm poultry workers visiting Ghana was estimated to be medium (high uncertainty.)

Summary

Table 4.7: Summary for CI risk pathway 6

Step of pathway	Information obtained	Source	Risk Category	Uncertainty
Probability of infection on small farm in CI	Prevalence	OIE-WAHIS	Medium	Medium
Probability of contamination of poultry workers on small farm in CI, given the farm is infected.	Human vectors	Kasemsuwan et al. 2008	High	Medium
Probability of poultry workers visiting Ghana	Frequency of visits Entry points	VCA Unity Farms VCA Unity Farms/ GIS	Medium	High

Overall risk estimate and conclusion for pathway 6

The risk estimate for pathway 6 was calculated by combining the risk categories summarized in Table 4.7, using the combination matrix presented in the approach. The pathway had 3 parameters/steps. Parameters 1 and 3 were estimated as medium risks with parameter 2 being high. The combination of medium (parameter 1) and high (parameter 2) becomes medium which when combined with medium (parameter 3) remains medium. In effect, the risk of re-introduction of HPAI via poultry workers is medium, with high uncertainty.

The step of pathway 6 associated with the higher risk category was the probability of contamination of poultry workers on small farms in CI given a farm is infected.

4.8 Overall risk estimate and conclusions for the risk of re-introduction of HPAI virus into Ghana from Cote d'Ivoire

Table 4.8: Summary of risk estimates for introduction of HPAI H5N1 from Cote d'Ivoire to Ghana.

Risk Pathway	Probability and Uncertainty Estimate
Risk of introduction of H5N1 into Ghana via infected live birds originating from large farms in CI	Negligible with high uncertainty
Risk of introduction of H5N1 into Ghana via contaminated eggs/egg trays originating from large farms in CI	Negligible with high uncertainty
Risk of introduction of H5N1 into Ghana via infected DOC originating from large farms in CI	Negligible with high uncertainty
Risk of introduction of H5N1 into Ghana via contaminated traders originating from large farms in CI	Negligible with high uncertainty
Risk of introduction of H5N1 into Ghana via contaminated feeds and raw materials originating from small farms in CI	Negligible with high uncertainty
Risk of introduction of H5N1 into Ghana via contaminated poultry workers originating from small farms in CI	Medium with high uncertainty

Overall, the risk of introduction of H5N1 into Ghana from CI ranged from Negligible to Medium with high uncertainty.

Although there has been a ban on importation of poultry, poultry products and feed from Cote d'Ivoire to Ghana since the outbreak in 2006, there is evidence of active cross-border transport of eggs, spent layers and some feedstuff providing a clear and present risk. The presence of farms with entities across the border in the two countries makes the risk even greater.

The steps of the pathway for introduction of HPAI from CI to Ghana associated with higher risk included

- The probability of introduction of live birds
- The probability of introduction of eggs and egg trays
- The probability of introduction of DOC
- The probability of contamination of traders on infected large scale farm
- The probability of contamination of poultry workers on infected small farms.

Recommendation

There were considerable data gaps which made uncertainty high. Hardly any data were available and even when available these varied between sources so that credibility was a problem. Future research should target the missing data links to provide credible information to reduce uncertainty. The absence of credible data therefore, makes a recommendation of quantitative risk assessment as a further stem unwarranted.

4.9 Pathway II: Re-introduction of HPAI virus into Ghana from Burkina Faso

Overview of information required for pathway II

The data needs and information sources for release pathway II involving risks from Burkina Faso are presented in Table 4.9.

Table 4.9: Data needs and information sources for Burkina Faso Risk pathway

Step of risk pathway	Data needs	Data source
Risk of infection of household birds	Prevalence in BF Species and population size of birds Type of birds	OIE – WAHIS FAO Literature
Risk of transporting infected birds (guinea fowl and local birds)	Volume and frequency of trade Entry points Incubation period Travel time	VCA from FAO/VSD Ghana Immigration Service Literature Fowl sellers association.
Risk of transporting contaminated Guinea fowl eggs	Volume and frequency of trade Entry points Virus survival in/on the egg Travel time	VCA from FAO Ghana Immigration Service Literature Fowl sellers association.
Risk of contamination of baskets and egg containers	Capacity of the container and Frequency of use Type of container Entry points Virus survival on the containers Travel time	Fowl sellers' association Fowl sellers' association Ghana Immigration Service Literature Fowl sellers' association.
Risk of contamination of traders	Frequency of traders visiting Ghana Points of entry	Fowl sellers' association Ghana Immigration Service
Risk of contamination of vehicles (motorbikes, bicycles and cars)	Frequency of visits to farms in BF Points of entry	Fowl sellers assoc. in BF Ghana Immigration Service
Risk of contamination of maize during sun-drying process	Exposure of maize during sun-drying to wild and scavenging birds (yes/no) Volume of maize exported from BF to Ghana Length of sun-drying time Virus survival in Maize Prevalence in wild birds and scavenging birds	Maize sellers association Customs and MOTI (Trade and Industry) Maize sellers association Literature review CVO BF

Data Collection

The questionnaire for Burkina Faso was sent by email to the Chief Veterinary Officer (Burkina Faso) on 10th February 2009. No response was received up to middle of March 2009 despite reminders. Another veterinarian, Dr Germaine Minoungou was approached whose response was received on 23rd March 2009. Other people/institutions in Ghana were contacted between February and March 2009 to respond to the questionnaire. They were:

- The Acting Director of Veterinary Services, Ghana (Dr E M B Koney)
- Dr A Akunzule, a veterinarian and founder, Ghana Poultry Network, Ghana
- Dr F. Konadu-Ampratwum, a deputy director of Veterinary Services in charge of public health and a member of the AIWG.
- Greater Accra Poultry Farmers Association (represented by Mr Seth Wilson)
- Oyarifa Livestock Farmers Association (represented by Mr John Torto)
- Statistical Research and Information Directorate of MOFA, Accra Ghana
- Livestock Planning and Information Unit of MOFA, Ghana

All these sources provided no answers for most of the questions.

Attempts were made for supplementary data through extensive electronic literature search. Grey literature was also obtained from sources within Ghana to complement the literature search.

4.10 Pathway 1 BF: Re-introduction via infected live household birds

Probability of infection of household birds

Description of information available

The poultry population in Burkina Faso in 2007 was estimated at 32 million with about 80% kept in households (Dr Minoungou). The household birds were made up of about 70% chickens, 19% guinea fowls, 4% pigeons with the rest made up of turkeys and ducks. The prevalence of HPAI infection in household birds was not known. However, the prevalence of AI in guinea fowls or local birds in BF in 2006 when there was an outbreak was 0% (Dr Minoungou, citing website). An OIE report stated that an outbreak in Gampela and Saaba on 1 March 2006 was in helmeted guinea fowls with a total of 130 cases (apparent morbidity of 100%; apparent mortality of 94.6% and apparent case fatality of 94.6% (OIE-WAHIS 2006).

Interpretation

The probability of infection of household birds was estimated as low with high uncertainty. This is because of a report of an outbreak in guinea fowls in 2006.

Probability of transporting birds (guinea fowl and local birds) into Ghana market

Description of information available

There was no information on the volume and frequency of trade of guinea fowls and local birds. However, an estimate of 50,000 guinea fowls and 30,000 local birds was given by Dr Ampratwum as the volume exported to Ghana from Burkina Faso in 2007. These birds were transported daily (Dr Minoungou; Dr Ampratwum; Dr Akunzule) and entered Ghana through Tumu, Paga and Bawku (Dr Ampratwum) and also Yelewongo (Dr Akunzule). An estimate of an average of one day was given as the travel time for guinea fowls or local birds from markets in Burkina Faso to Ghana border towns (Dr Ampratwum). Another estimate was an average of 2.5 days (Dr Minoungou).

There is no information available on the incubation period of HPAI H5N1 virus in guinea fowls or local birds.

Interpretation

The probability of transporting household birds into Ghana markets (guinea fowl and local birds) is high (medium uncertainty) because of the frequent movement of people and goods (including live birds) to markets across borders.

Summary

Table 4.10: Summary for BF risk pathway 1

Step of pathway	Information obtained	Source	Risk Category	Uncertainty
Probability of infection of household birds	Prevalence in BF Species and population size Types of bird	Dr Minoungou Dr Minoungou Dr Minoungou	Low	High
Probability of transporting household birds to Ghana market.	Volume and frequency Entry points Travel time	Dr Ampratwum/Dr Akunzule/Dr Minoungou Dr Ampratwum/ Dr Akunzule Dr Ampratwum/Dr Minoungou	High	Medium

Overall risk estimate and conclusion for BF pathway 1

The risk estimate for pathway 1 was calculated by combining the risk categories summarized in Table 4.10, using the combination matrix presented in the approach. The pathway is made up of 2 parameters/steps. Parameter 1 was estimated as low risk while parameter 2 was high. When combined, the two risks result in a low risk category. The risk of re-introduction of HPAI via infected household birds from BF is, therefore, low with high uncertainty.

The step of BF pathway 1 associated with the higher risk category was the probability of introduction of live household birds from BF to Ghana market.

4.11 Pathway 2 BF: Re-introduction via contaminated guinea fowl eggs

Probability of infection of household birds

See section 4.10.1

Probability of contamination of Guinea fowl eggs given a farm is infected.

Description of information available

There is no specific information on virus survival in or on guinea fowl eggs. However, literature suggests that the H5N2 virus retained infectivity in droppings of faeces at 25 degrees Celsius for 2 days (Beard et al. 1984 cited by Marce 2008), but H5N1 HP/Asia virus in chicken faeces showed no infectivity after 30 min exposure to sunlight at 32-35 degrees Celsius and after 4 days in the shade at 25-32 degrees Celsius (Songserm et al., 2005, cited by Marce, 2008). The contamination on the eggs is likely to be through the faeces (Swayne and Beck 2004). There is the possibility that the virus particles may pass through the shell into an egg since the pores in egg shells are 200-600nm in diameter and the AI virus is just about 100nm (Doyle et al., 2007). There is evidence that HPAI virus can penetrate intact eggs (Wiwanitkit, 2007).

The probability of HPAI virus surviving on egg shells was estimated by (Songserm, 2008 cited by Kasemsuwan et al. 2008) as being low.

Interpretation

The probability of contamination of guinea fowl eggs is low (medium uncertainty) because even if the faecal droppings of infected birds are likely to have the virus and might contaminate the egg shells, the survival of the virus on the egg shell is low.

Probability of transporting Guinea fowl eggs to Ghana markets

Description of information available

No information was available on the volume of guinea fowls eggs exported from Burkina Faso into Ghana in 2007. An estimate of 30,000 eggs has been given (Dr Ampratwum). These eggs were sent on daily basis and it took on average one day for the eggs to be sent from markets in Burkina Faso to Ghana border towns. There are many market days in a week across both countries and these offer opportunities for eggs to be sent to markets for sale. The entry points were Tumu, Paga and Bawku (Dr Ampratwum) and also Yelewongo (Dr Akunzule).

Interpretation

The probability of transporting guinea fowl eggs is high (medium uncertainty) because of the frequent movement of people and goods (including guinea fowl eggs) to markets across borders.

Summary

Table 4.11: Summary for BF risk pathway 2

Step of pathway	Information obtained	Source	Risk Category	Uncertainty
Probability of infection of household birds	Prevalence in BF Species and population size Types of bird	Dr Minoungou Dr Minoungou Dr Minoungou	Low	High
Probability of contamination of guinea fowl eggs.	Virus survival	Beard et al (1984), Songserm et al (2005), Swayne and Beck (2004), Doyle et al (2007), Wiwanitkit (2007), Songserm (2008)	Low	Medium
Probability of transporting guinea fowl eggs to Ghana market.	Volume and frequency Travel time Entry points	Dr Ampratwum Dr Ampratwum /Dr Akunzule Dr Ampratwum	High	Medium

Overall risk estimate and conclusion for BF pathway 2

The risk estimate for pathway 2 was calculated by combining the risk categories summarized in Table 4.11, using the combination matrix presented in the approach. There were 3 parameters/steps: Parameters 1 and 2 were estimated as low risk and parameter 3 as high risk. Combining the first 2 risks results in very low risk which on further combination with parameter 3 results in very low risk. The risk of re-introduction of HPAI via contaminated guinea fowl eggs from BF was, therefore, very low with high uncertainty.

The step of BF pathway 2 associated with the higher risk category was the probability of transporting of guinea fowl eggs from BF to Ghana market.

4.12 Pathway 3 BF: Re-introduction via contaminated baskets and egg crates from households

Probability of infection of household birds

See section 4.10.1

Probability of contamination of baskets and egg containers, given household birds are infected.

Description of information available

Straw baskets with capacities for 5, 10, 20, 30 or 50 birds were used in carrying live guinea fowls which soil these with faecal droppings while being transported (Dr Ampratwum; Dr Akunzule). These baskets were often re-used till they were no longer usable (Dr Minoungou; Dr Ampratwum). Straw baskets were also used for the guinea fowl eggs with 36-egg capacity and these might be contaminated by faecal droppings (Dr Ampratwum). There is no information on virus survival on straw.

Interpretation

The probability of contamination of baskets and egg containers given that household birds are infected is high (high uncertainty) because infected birds shed the virus through faecal droppings which contaminate the baskets and eggs.

Probability of transporting baskets and egg containers to markets in Ghana

Description of information available

The entry points in Ghana were similar to those for live birds and traders. The travel time to Ghana border times was estimated as one day (Dr Ampratwum). The perception of participants at the workshop was that this was a major risk. However, there is no evidence to support such perception.

Interpretation

The probability of transporting baskets and egg containers to Ghana markets is high (high uncertainty) because of the frequent movement of people and goods (including live birds and eggs carried in baskets and egg containers) to markets across borders.

Summary

Table 4.12: Summary for BF risk pathway 3

Step of pathway	Information obtained	Source	Risk Category	Uncertainty
Probability of infection of household birds	Prevalence in BF Species and population size Types of bird	Dr Minoungou Dr Minoungou Dr Minoungou	Low	High
Probability of contamination of baskets and egg containers given that household birds are infected.	Capacity of carriers Frequency of use	Dr Akunzule/ Dr Ampratwum Dr Akunzule/ Dr Minoungou	High	High
Probability of transporting baskets and egg containers to Ghana market.	Frequency of trade Entry points Travel time	Dr Akunzule/ Dr Minoungou Dr Akunzule/ Dr Ampratwum Dr Ampratwum	High	High

Overall risk estimate and conclusion for BF pathway 3

The risk estimate for pathway 3 was calculated by combining the risk categories summarized in Table 4.12, using the combination matrix presented in the approach. There were 3 parameters/steps in the pathway with low, high and high risks, respectively. On combining, low X high = low. The risk of re-introduction of HPAI via contaminated baskets and egg containers from BF is, in effect, low, with high uncertainty.

The steps of BF pathway 3 associated with the higher risk category were the probabilities of contamination of baskets and egg containers and of transporting these from BF to Ghana market.

4.13 Pathway 4 BF: Re-introduction via traders visiting households

Probability of infection of household birds

See section 4.10.1

Probability of contamination of traders

Description of information available

Humans are potential mechanical vectors for introduction of HPAI virus (Kasemsuwan et al., 2008). Traders move from farm to farm to obtain live birds or eggs and then from market to market. They are likely to be contaminated when visiting infected farms or premises, if the necessary bio-security measures are not in place. Traders were considered by the workshop participants as the highest risk population since they moved from farm to farm and then from market to market.

Interpretation

The probability of contamination of traders given that they visit households with infected birds is high (medium uncertainty) because infected birds shed the virus which can contaminate humans.

Probability of traders visiting Ghana

Description of information available

There was no reliable information on the number of guinea fowl traders in BF in 2007 or on the proportion visiting or frequency of visits to Ghana in any one month. The entry points in Ghana were identified as Tumu, Paga and Bawku (Dr Ampratwum) or Yelewongo (Dr Akunzule). Traders send poultry and poultry products to markets across borders.

Interpretation

The probability of guinea fowl traders visiting Ghana is estimated to be medium (medium uncertainty) because of the frequent movement of people and goods to markets across borders.

Probability of contamination of vehicles (motorbikes, bicycles and cars)

Description of information available

There was no information on the frequency of vehicular visits to farms in BF. It has been reported that the environment in Thailand allowed HPAI virus to remain viable on vehicles for less than 2 hours and there was low opportunity of vehicle's wheels and trunk being used to mechanically transmit HPAI virus (Kasemsuwan et al. 2008). The harsher environmental conditions of high temperature and heat in BF might make survival on tyres and trunk more difficult. It is reported that AI viruses are relatively unstable in the environment, being susceptible to heat, pH extremes and dryness, but cool moist conditions and organic matter can extend their viability (Doyle et al. 2007). There is a report that an LPAI virus survived for at least 3 days at room temperature (not defined) on the surface of tire, steel and plastic (Doyle et al., 2007).

Interpretation

The probability of contamination of vehicles is very low (medium uncertainty) because of low survival of the virus on vehicles and at high environmental temperatures and heat.

Probability of vehicles (motorbikes, bicycles and cars) visiting Ghana

Description of information available

Vehicles may be considered as potential mechanical vectors for the introduction of HPAI virus (Kasemsuwan et al., 2008). Information gathered at the workshop in November 2008 indicated that motor cycles and bicycles were common means for transporting live guinea fowls and eggs from farm to markets within BF and also to markets within Ghana. The points of entry are similar to those noted for traders and it was these who used the vehicles.

Interpretation

The probability of vehicles visiting Ghana market was very high (medium uncertainty). There is frequent movement especially on bicycles and motor-bikes to markets on market days across borders.

Summary

Table 4.13: Summary for BF risk pathway 4

Step of pathway	Information obtained	Source	Risk Category	Uncertainty
Probability of infection of household birds	Prevalence in BF Species and population size Types of bird	Dr Minoungou Dr Minoungou Dr Minoungou	Low	High
Probability of contamination of traders	Human vectors	Kasemsuwan et al. 2008	High	Medium
Probability of traders visiting Ghana market.	Points of entry	Dr Akunzule/ Dr Ampratwum	Medium	Medium
Probability of contamination of vehicles	Virus survival	Kasemsuwan et al., 2008	Very low	Medium
Probability of traders using vehicles (motorbikes, bicycles and cars) to visit Ghana markets.	Frequency of visits to market	Workshop	Very high	Medium

Overall risk estimate and conclusion for BF pathway 4

The risk estimate for pathway 4 was calculated by combining the risk categories summarized in Table 4.13, using the combination matrix presented in the approach. The pathway had 5 steps/parameters. The risk estimates were low, high, medium, very low and very low for the steps. When combined in sequential order low X high = low; low X medium = very low; very low X very low = negligible; negligible X very high = negligible. The risk of re-introduction of HPAI via contaminated traders from BF is, therefore, negligible with high uncertainty.

The step of BF pathway 4 associated with the higher risk category was the probability of traders from BF visiting markets in Ghana using vehicles (motor bikes, bicycles and cars).

4.14 Pathway 5 BF: Re-introduction via maize used for poultry feeding

Probability of infection in wild and scavenging birds

Description of information available

The prevalence of AI in wild and scavenging birds in BF in 2006 (when there was an outbreak) was estimated as 0% (Dr Minoungou; Dr Ampratwum). There is a report that hooded vultures (*Necrosyrtes monachus*) in BF became ill presumably after consuming infected birds (Ducatez et al., 2007). These authors concluded that hooded vultures could potentially be vectors or sentinels of HPAI H5N1. BF has wetlands that are part of the Migratory Bird flyway in Africa. OIE (2007) argued that countries with large wetlands that are destinations of wild bird migrating directly from infected countries are to be considered as being at relatively high risk of HPAI H5N1 virus incursion, especially in areas of high agricultural production and where poultry are in contact with wild birds. Outbreaks in Thailand and Japan were most frequently associated with Passerifomes birds including crows (Kasemsuwan et al. 2008). House sparrows experimentally infected with HPAI shed the largest amount of virus (Greiner et al., 2007). In Cote d'Ivoire, HPAI was confirmed in sparrow hawks in 2006

Interpretation

The probability of infection of wild and scavenging birds was estimated as very low (medium uncertainty). This is because there were no confirmed reports in wild birds in BF, but a neighbouring country, CI had reported of detection in a wild bird.

Probability of contamination of maize during sun-drying process

Description of information available

The proportion of maize in BF dried in the sun was estimated to be 100% with average drying time of 30 days (Dr Ampratwum). The maize was exposed to wild and scavenging birds during sun drying. There is no information on virus survival in maize. The contamination is likely to be through faeces. However, literature suggests that the H5N2 virus retained infectivity in droppings of faeces at 25 degrees Celsius for 2 days (Beard et al. 1984 cited by Marce 2008), but H5N1 HP/Asia virus in chicken faeces showed no infectivity after 30 min exposure to sunlight at 32-35 degrees Celsius and after 4 days in the shade at 25-32 degrees Celsius (Songserm et al., 2005, cited by Marce, 2008). Solar and UV radiation inactivate Influenza A virus (Sagripanti and Lytle, 2007)

Interpretation

The probability of contamination of maize during sun-drying process is negligible (high uncertainty) because the sun-drying process and the length of period are likely to inactivate the virus.

Probability of importation of maize from BF to Ghana for poultry feed formulation

Description of information available

There was no reliable information on the volume of maize exported to Ghana from BF. An estimate of 30,000 kg for 2007 has been given (Dr. Ampratwum). At the workshop it was noted that during

periods of shortage of maize on the market, maize might be imported from BF to Ghana markets and could be available for use in poultry feeding.

Interpretation

The probability of importing sun-dried maize for poultry feed formulation was low (high uncertainty).

Summary

Table 4.14: Summary for BF risk pathway 5

Step of pathway	Information obtained	Source	Risk Category	Uncertainty
Probability of infection of wild and scavenging birds	Prevalence	Dr Minoungou/ Dr Ampratwum Ducatez et al 2007	Very low	Medium
Probability of contamination of maize during sun-drying process	Proportion of maize sundried Length of sun drying process Virus survival	Dr Ampratwum Dr Ampratwum Beard et al 1984	Negligible	High
Probability of importation of maize from Bf to Ghana	Volume imported	Dr Ampratwum	Low	High

Overall risk estimate and conclusion for BF pathway 5

The risk estimate for pathway 5 was calculated by combining the risk categories summarized in Table 4.14, using the combination matrix presented in the approach. There were 3 parameters /steps in the pathway. Parameter 1 was estimated as having very low risk, parameter 2 negligible and parameter 3 low. Combining the first 2 risk estimates results in negligible risk which on further combination with the last risk estimate remain as negligible. The risk of re-introduction of HPAI via maize from BF is, therefore, negligible with high uncertainty.

The step of BF pathway 5 associated with the higher risk category was the probability of maize being imported from BF into Ghana for use in poultry feed formulation.

4.15 Overall risk estimate and conclusions for the risk of re-introduction of HPAI virus into Ghana from Burkina Faso

Table 4.15 shows a summary of risk estimates for introduction of HPAI H5N1 from BF to Ghana.

Table 4.15: Summary of risk estimates for introduction of HPAI H5N1 from Burkina Faso to Ghana.

Risk Pathway	Probability and Uncertainty Estimate
Risk of introduction of H5N1 into Ghana via infected household birds in BF	Low with high uncertainty
Risk of introduction of H5N1 into Ghana via contaminated guinea fowl eggs from households in BF	Very low with high uncertainty
Risk of introduction of H5N1 into Ghana via contaminated baskets/ egg crates from households in BF	Low with high uncertainty
Risk of introduction of H5N1 into Ghana via contaminated traders visiting households in BF	Negligible with high uncertainty
Risk of introduction of H5N1 into Ghana via contaminated maize during sun drying in BF	Negligible with high uncertainty

Overall, the risk of introduction of H5N1 into Ghana from Burkina Faso ranged from Negligible to Low with high uncertainty.

The absence of reliable information made the estimation difficult and at best should be interpreted with caution. The regular trade flow to and out of Ghana on market days in markets near border towns in both countries make control of movement of poultry, poultry products, fomites and people very challenging. The steps of the pathway for the introduction of HPSAI from BF to Ghana markets associated with higher risks were

- The probability of introducing live household birds
- The probability of transporting guinea fowl eggs
- The probability of contamination of baskets and egg containers
- The probability of transporting baskets and egg containers
- The probability of traders using vehicles to markets
- The probability of maize being imported for use in poultry feed formulation in Ghana

Recommendation

There were considerable data gaps which made uncertainty high. Future research should target collecting data that provides credible information to reduce uncertainty. The steps identified as having higher risks in each pathway could be targeted for control purposes. The dearth and/ or low credibility of data makes it difficult for me to recommend Quantitative Risk Assessment as a further step.

4.16 Pathway III: Re-introduction of HPAI virus into Ghana from Togo

Overview of information required for pathway III

The data needs and information sources for release pathway III involving risks from Togo are presented in Table 4.16.

Table 4.16: Data needs and information sources for Togo Risk pathway

Step of risk pathway	Data needs	Data source
Risk of infection in household birds	Prevalence in Togo Species and population size of birds Type of birds	OIE – WAHIS FAO Literature
Risk of transporting an infected bird	Volume and frequency of trade Entry points Incubation period Travel time	VCA from FAO Ghana immigration Service Literature ?
Risk of contamination of poultry workers	Frequency of PFW visiting Ghana Points of entry	Poultry association in Togo Ghana immigration Service
Risk of contamination of anchovies during sun-drying process in Togo	Exposure of anchovies during storage and sun-drying Volume of anchovies exported from Togo to Ghana Length of sun-drying time Virus survival Prevalence in wild birds and scavenging birds	Fish sellers association in Togo Customs and MOTI (Trade and Industry) Fish sellers association in Togo Literature review CVO Togo
Risk for contamination of anchovies during transportation in containers	Volume transported Type of transport / packaging Virus survival in packaging Travel time	Fish sellers association in Togo Fish sellers association in Togo Literature review Fish sellers association
Risk of contamination of anchovies at the market	Origin of anchovies Volume of anchovies at the market Virus survival Type of adulteration	Fish sellers Association Fish sellers Association Literature review End-users in Ghana / poultry farmers / millers
Probability of countries of origin exporting infected frozen turkey tails and poultry carcasses to Togo	List of countries Volume Virus survival in meat and to freezing process Date of import into Togo	FAO statistics FAO Literature ?
Risk of export of infected frozen turkey tails and poultry carcasses to Ghana	Volume Time of travel Type of transport (Conditions of storage during travel) Virus survival	Customs and VCA-FAO or DFID ? ? Literature
Risk of contamination of vehicles during outbreak in Togo	Number of vehicles entering Ghana through approved entry points Starting points and routes Virus survival on vehicles	Customs Customs Literature
Risk of vehicle disinfection process being ineffective.	Disinfection procedure Virus survival to disinfection	VSD Literature

Data Collection

The questionnaire for Togo was sent by email to the Chief Veterinary Officer (Dr Batasse Batawui) on 10th February 2009. No response was received up to middle of March 2009 despite many reminders. Other sources contacted in Togo in March 2009 included the following:

- ANPAT, the national poultry farmers' association
- BNCRA, the Togolese Chamber of Commerce
- Dr Karim Misbah, a government veterinarian
- Dr Hounkanli, The National Consultant for HPAI in 2007
- Dr Apetoffia Kossivi of the National Veterinary Order

No responses had been received from any of these sources as at 15th May 2009.

Other people/institutions in Ghana were contacted in February and March 2009 to respond to the questionnaire. They were:

- The Acting Director of Veterinary Services, Ghana (Dr E M B Koney)
- Dr A Akunzule, a veterinarian and founder, Ghana Poultry Network, Ghana
- Dr Konadu-Ampratwum, a deputy director of Veterinary Services in charge of public health and a member of the AIWG.
- Greater Accra Poultry Farmers Association (represented by Mr Seth Wilson)
- Oyarifa Livestock Farmers Association (represented by Mr John Torto)
- Statistical Research and Information Directorate of MOFA, Accra Ghana
- Livestock Planning and Information Unit of MOFA, Ghana

Most of these sources did not answer most of the questions because they had no idea or they did not have the information requested.

Attempts were made for supplementary data through extensive electronic literature search. Grey literature was also obtained from sources within Ghana to complement the literature search.

4.17 Pathway 1 Togo: Re-introduction via infected live household birds

Probability of infection in household birds

Description of information available

The prevalence of HPAI infection in household birds in Togo was not known. Neither was information available on the species, type and population size of household birds. Outbreaks of HPAI in Togo in 2007 and 2008 were in chicken in intensive farming systems (OIE-WAHIS, 2008).

Interpretation

The probability of infection of household birds was estimated to be low (high uncertainty) because the outbreaks occurred in intensively-managed farms.

Probability of transporting birds into Ghana

Description of information available

There was no information on the volume and frequency of trade in household birds. At the workshop, it was noted that the frequent movement of people across the borders on daily basis through approved and unapproved routes presented a risk which cannot be quantified. An estimate of 10,000 household birds is exported annually (Dr Ampratwum). These birds are sent on daily basis and enter Ghana through Aflao, Dzodze and Nyive (Dr Ampratwum). A list of approved and known unapproved entry points are listed in Annex 5. An estimate of an average on one day was given as the travel time for household birds from points of origin in Togo to town borders in Ghana (Dr Ampratwum).

There is no information available on the incubation period of HPAI H5N1 virus in the local birds.

Interpretation

The probability of transporting household birds is medium (high uncertainty) people move frequently across the borders visiting relatives and friends and may carry birds as gifts or for consumption.

Summary

Table 4.17: Summary for Togo risk pathway 1

Step of pathway	Information obtained	Source	Risk Category	Uncertainty
Probability of infection of household birds	Prevalence	OIE-WAHIS	Low	High
Probability of transporting birds to Ghana.	Volume Frequency Entry points	Dr Ampratwum Workshop Dr Ampratwum/ GIS	Medium	High

Overall risk estimate and conclusion for Togo pathway 1

The risk estimate for pathway 1 was calculated by combining the risk categories summarized in Table 4.17, using the combination matrix presented in the approach. There were 2 parameters/steps with risk estimates of low and high. On combination the risk becomes very low. The risk of re-introduction of HPAI via infected household birds from Togo is, therefore, very low with high uncertainty.

The step of Togo pathway 1 associated with the higher risk category was the probability of introduction of live household birds from Togo into Ghana.

4.18 Pathway 2 Togo: Re-introduction via poultry workers

Probability of outbreak in Togo

Description of information available

Outbreaks of HPAI in Togo in 2007 and 2008 were in chicken in intensive farming systems (OIE-WAHIS, 2008). The outbreaks in June 2007 were on poultry farms in the southern part of the country

while an outbreak in September 2008 was on a poultry farm in Agbata near Lome (the capital). The suspected "endemicity" of HPAI in Nigeria presents a risk to Benin and by extension to Togo.

Interpretation

The probability of an outbreak in Togo was estimated to be medium (high uncertainty) because of recent outbreaks in that country and the continued presence of the virus in the West African region.

Probability of contamination of poultry workers given there is an outbreak

Description of information available

Humans are potential mechanical vectors for introduction of HPAI virus, especially the poultry farm workers who work on farms (Kasemsuwan et al., 2008). These workers were considered by the workshop participants as a potential risk population. These workers may use gum boots and there is a report that an LPAI virus survived for at least three days at room temperature (undefined) on gum boots (Doyle et al., 2007). There is no information on the bio-security measures instituted on farms in Togo in the absence of outbreaks. Control measures during outbreaks included quarantine, movement control, screening and disinfection of premises (OIE-WAHIS, 2007).

Interpretation

The probability of contamination of poultry workers given there is an outbreak is high (medium uncertainty) because birds shed the virus and in the absence of effective bio-security measures and procedures this could lead to workers being contaminated.

Probability of poultry workers visiting Ghana

Description of information available

There was no reliable information on the number of poultry farm workers in Togo in 2007 or on the proportion visiting Ghana in any one month. The entry points identified were Aflao, Segbe, Akanu and Shia (Dr Ampratwum). Annex 5 shows approved and known unapproved entry points.

Interpretation

The probability of poultry workers visiting Ghana is estimated to be low (high uncertainty).

Summary

Table 4.18: Summary for Togo risk pathway 2

Step of pathway	Information obtained	Source	Risk Category	Uncertainty
Probability of outbreak in Togo	Prevalence	OIE-WAHIS	Medium	High
Probability of contamination of poultry workers	Human vectors	Kasemsuwan et al., 2008	High	Medium
Probability of poultry workers visitng Ghana.	Entry points	Dr Ampratwum/ GIS	Low	High

Overall risk estimate and conclusion for Togo pathway 2

The risk estimate for pathway 2 was calculated by combining the risk categories summarized in Table 4.18, using the combination matrix presented in the approach. There were 3 parameters /steps in the pathway with medium, high and low risks, respectively. On combination, medium X high = medium, which combines further with low to give very low risk. The risk of re-introduction of HPAI via infected household birds from Togo is very low, with high uncertainty.

The step of Togo pathway 1 associated with the higher risk category was the probability of contamination of poultry workers in Togo.

4.19 Pathway 3 Togo: Re-introduction via anchovies

Probability of infection in wild and scavenging birds

Description of information available

The prevalence of AI in wild and scavenging birds in Togo is not known. There are no confirmed reports of deaths in wild and scavenging birds in Togo from HPAI infection (OIE-WAHIS).

Interpretation

The probability of infection wild and scavenging birds was estimated to be negligible (High uncertainty) because there are no confirmed outbreaks in wild birds in Togo.

Probability of contamination of anchovies during sun-drying process in Togo

Description of information available

There was no reliable information on the volume of anchovies exported to Ghana from Togo. An estimate of 10,000 kg for 2007 has been given (Dr. Ampratwum). The proportion of anchovies in Togo dried in the sun was estimated to be 100% with average drying time of 15 days (Dr. Ampratwum). The anchovies were exposed to wild and scavenging birds during sun drying.

There is no information on virus survival in anchovies. The contamination is likely to be through faeces. However, literature suggests that the H5N2 virus retained infectivity in droppings of faeces at 25 degrees Celsius for 2 days (Beard et al. 1984 cited by Marce 2008), but H5N1 HP/Asia virus in chicken faeces showed no infectivity after 30 min exposure to sunlight at 32-35 degrees Celsius and after 4 days in the shade at 25-32 degrees Celsius (Songserm et al., 2005, cited by Marce, 2008)

The expected inactivation of Influenza A virus by solar ultraviolet radiation has been described for many cities of the world by Sagripanti and Lytle (2007).

Interpretation

The probability of contamination of anchovies during sun-drying process is negligible (high uncertainty) because the virus is inactivated by the high temperatures and length of drying period used.

Probability of contamination of anchovies during transportation in containers

Description of information available

Anchovies are packed in poly sacs made up of non-porous material and water-proof for storage and transport (Dr. Ampratwum) to avoid the fish getting soaked leading to spoilage. There is no information on the volume transported and the type of transport used. There is also no information on HPAI virus survival in polysterene material. However, it has been reported that an LPAi virus survived for at least three days at undefined room temperature on plastic or two days on poly ester fabric (Doyle et al., 2007).

Interpretation

The probability of contamination of anchovies during transportation in containers is very low (high uncertainty) because the virus may not survive in the type of packaging used.

Probability of contamination of anchovies at the market

Description of information available

There is no information on the volume of anchovies in the market or virus survival in polysterene material or in sand. It was reported at the workshop that to increase weights the anchovies in the polysterene sacks were adulterated with sand. The workshop noted the possibility of cross-contamination in markets resulting in contaminated anchovies being sold.

Interpretation

The probability of contamination of anchovies at markets is very low (high uncertainty) because the virus may not survive in the type of packaging used.

Probability of anchovies being used as poultry feed in Ghana

Description of information available

Most of the anchovies on Togo market came from Lome and it was estimated that about 2% of the anchovies exported to Ghana for formulation of poultry feed was obtained from markets in Togo (Dr Ampratwum). It took on average one day to transport anchovies from points of origin in Togo to border towns in Ghana (Dr Ampratwum).

Interpretation

The probability of using anchovies from Togo for poultry feed formulation in Ghana is high (high uncertainty) because anchovies is a common protein source used in poultry feed formulation.

Summary

Table 4.19: Summary for Togo risk pathway 3

Step of pathway	Information obtained	Source	Risk Category	Uncertainty
Probability of infection in wild and scavenging birds	Prevalence	OIE-WAHIS	Negligible	High
Probability of contamination of anchovies during sun-drying process	Volume Virus survival Length of sun-drying process	Dr Ampratwum Beard et al. 1984 Dr Ampratwum	Negligible	High
Probability of contamination of anchovies during transportation in containers	Type of packaging Virus survival	Dr Ampratwum Doyle et al 2007	Very low	High
Probability of contamination of anchovies at markets in Togo	Cross contamination	Workshop	Very low	High
Probability of anchovies being used as poultry feed in Ghana	Volume Travel time	Dr Ampratwum Dr Ampratwum	High	High

Overall risk estimate and conclusion for Togo pathway 3

The risk estimate for pathway 3 was calculated by combining the risk categories summarized in Table 4.19, using the combination matrix presented in the approach. There were 5 parameters or steps in the pathway. On combination negligible X negligible = negligible; negligible X very low= negligible; and negligible X high = negligible. In effect, the risk of re-introduction of HPAI via anchovies obtained for from Togo for poultry feed formulation is negligible, with high uncertainty.

The step of Togo pathway 3 associated with the higher risk category was the probability of anchovies being obtained from Togo for use in poultry feeding in Ghana.

4.20 Pathway 4 Togo: Re-introduction via frozen turkey tails and carcasses

Probability of outbreak in countries of origin of poultry exports to Togo

Description of information available

The major countries of origin of poultry imports into Togo in 2003 were France, Spain, Germany, Italy, United Kingdom and Denmark (Badje 2008). These countries have not reported outbreaks of HPAI in commercial poultry in recent years (OIE-WAHIS).

Interpretation

The probability of infection in poultry imported from exporting countries into Togo was negligible (medium uncertainty) because there have been no reported outbreaks in these countries for some time.

Probability of countries of origin exporting infected frozen turkey tails and poultry carcasses to Togo

Description of information available

HPAI have been detected in blood, bone, and breast and thigh meat of chickens (Swayne and Beck, 2005) and in frozen duck meat (Doyle et al, 2007). Doyle et al (2007) noted that although HPAI viruses are widespread in the tissues and presumably in eggs of sick birds, it was unlikely that infected meat or turkey meat or eggs would be offered for sale commercially on a large scale both because of bio-security measures required of farmers and producers and the fact that these birds rapidly died from the diseases. The possibility that some birds might have a subclinical infection could, however, never be discounted. There is no information on the number of farms in meat-exporting countries becoming infected before detection and the volume of meat exported during the said period.

Interpretation

The probability of countries of origin exporting infected frozen turkey tails and poultry carcasses to Togo is negligible (high uncertainty). This might be cause of strict export procedures in the exporting and importing countries.

Probability that frozen turkey tails and some poultry carcasses found in Ghana are from Togo

Description of information available

There is no information on the volume of frozen turkey tails or poultry carcasses exported from Togo to Ghana. However, it is estimated that about 5% of turkey tails and 1% of poultry carcasses imported into Togo might be re-exported to Ghana through smuggling by using human carriers through unapproved entry points (Dr Ampratwum) or use of passenger buses (Mr Wilson). It took on average one day to transport frozen turkey tails or poultry carcasses from points of origin in Togo to border towns in Ghana. It was argued at the workshop that the majority of turkey tails sold in Ghana came from Togo through unapproved routes even though there is a ban on importation of poultry and poultry products from Togo.

Interpretation

The probability that frozen turkey tails and some poultry carcasses found in Ghana are from Togo is high (high uncertainty), because even though Ghana has banned the importation of such products, the products continue to be seen on the local markets as a result of illegal importation through unapproved routes.

Summary

Table 4.20: Summary for Togo risk pathway 4

Step of pathway	Information obtained	Source	Risk Category	Uncertainty
Probability of infection in poultry in exporting countries	Exporting countries Prevalence	Badje, 2008 OIE-WAHIS	Negligible	Medium
Probability of countries of origin exporting infected frozen turkey tails and carcasses into Togo	Virus survival in meat	Doyle et al, 2008	Negligible	High
Probability that frozen turkey tails and some carcasses found in Ghana are from Togo.	Volume of trade Entry points Transport used	Dr Ampratwum Dr Ampratwum Dr Ampratwum	High	High

Overall risk estimate and conclusion for Togo pathway 4

The risk estimate for pathway 4 was calculated by combining the risk categories summarized in Table 4.20, using the combination matrix presented in the approach. The pathway had 3 parameters/steps. On combining negligible X negligible = negligible while negligible X high = negligible. The risk of re-introduction of HPAI via frozen turkey tails and carcasses from Togo is, in effect, negligible with high uncertainty.

The step of Togo pathway 4 associated with the higher risk category was the probability that frozen turkey tails and some poultry carcasses found in Ghana are from Togo.

4.21 Pathway 5 Togo: Re-introduction via contaminated vehicles

Probability of outbreak in Togo

Description of information available

The last outbreak in Togo was in November 2008 in an intensively managed farm (OIE, 2008). The existence of a suspected “endemic” situation in Nigeria continues to be a concern and a clear and present risk. A new virus strain similar to strains identified in 2007 in Italy, Afghanistan and Iran and genetically distinct from other forms detected in 2006 and 2007 has been reported in Nigeria (FAO, 2008). The FAO noted that international trade or illegal and unreported movement of poultry could be responsible and warned of an increase in the risk of an AI spread to other countries in West Africa.

Interpretation

The probability of outbreak in Togo is medium (high uncertainty) because of recent outbreaks in that country and the continued presence of the virus in the West African region.

Probability of contamination of vehicles

Description of information available

Vehicles may be considered as potential mechanical vectors for the introduction of HPAI virus (Kasemsuwan et al., 2008). It has been reported that the environment in Thailand allowed HPAI virus to remain viable on vehicles for less than 2 hours and there was low opportunity of vehicle’s wheels and trunk being used to mechanically transmit the HPAI virus (Kasemsuwan et al. 2008). The harsh

environmental conditions of high temperature and heat in West Africa might make survival on tyres and trunk of cars difficult.

Interpretation

The probability of contamination of vehicles is very low (medium uncertainty) because the virus survival on tires and in the environment of high temperature and heat is low.

Probability of vehicle disinfection process being ineffective

Description of information available

FAO (2006) noted that as an enveloped virus, influenza virus is susceptible to several disinfectants, including detergents. The major disinfection procedure for vehicles at Ghana's approved borders when there was an outbreak of AI in Togo was use of motorized sprays with detergents to disinfect vehicles and this was deemed to be quite effective (Dr Ampratwum). AI viruses have a lipid coat that makes them susceptible to detergents and various sanitizers including chlorinated compounds (Doyle et al. 2007).

Interpretation

The probability of vehicle disinfection process being ineffective is negligible (medium uncertainty). This is because the detergents and sanitizers being used have been shown to be effective against the virus.

Probability of vehicles visiting Ghana

Description of information available

The Lagos-Abidjan Corridor of the Trans-West-African-Highway links the coastal countries of West Africa together with free people and vehicular movement under the ECOWAS Protocol. Togo and Ghana are transit points along this highway so vehicles from Lagos to Abidjan pass through Togo to enter Ghana.

There was no information on the number of vehicles entering Ghana through approved points with their starting points and routes in Togo. The common starting points for vehicles arriving at border towns between Togo and Ghana are Lome and Aneho (Dr Ampratwum). The points of entry as given by the Ghana Immigration Service are shown in Annex 5.

Interpretation

The probability of vehicles from Togo visiting Ghana is very high (medium uncertainty). This is because of the high volume of movement on the West African Corridor of the Trans-Africa Highway.

Summary

Table 4.21: Summary for Togo risk pathway 5

Step of pathway	Information obtained	Source	Risk Category	Uncertainty
Probability of outbreak in Togo	Outbreak data	OIE-WAHIS / FAO 2008	Medium	Medium
Probability of contamination of vehicles in Togo	Virus survival	Kasemsuwan et al., 2008	Very low	Medium
Probability of disinfection process being ineffective	Virus survival Disinfection process	FAO 2006, Doyle et al 2007 Dr Ampratwum	Negligible	Medium
Probability of vehicles visiting Ghana	Entry points	Dr Ampratwum/ GIS	Very high	Medium

Overall risk estimate and conclusion for Togo pathway 5

The risk estimate for pathway 5 was calculated by combining the risk categories summarized in Table 4.21, using the combination matrix presented in the approach. There were 4 parameters/steps with the following risk estimates: medium, very low, negligible and very high. On combining medium X very low = very low; very low X negligible = negligible; negligible X very high = negligible. The risk of re-introduction of HPAI via vehicles from Togo is, therefore, negligible with medium uncertainty.

The step of Togo pathway 5 associated with the higher risk category was the probability of vehicles from Togo visiting Ghana.

4.22 Overall risk estimate and conclusions for the risk of re-introduction of HPAI virus into Ghana from Togo

Table 4.22 shows a summary of risk estimates for introduction of HPAI H5N1 from Togo to Ghana.

Table 4.22: Summary of risk estimates for introduction of HPAI H5N1 from Togo to Ghana.

Risk Pathway	**Probability and Uncertainty Estimate**
Risk of introduction of H5N1 into Ghana via infected household birds in Togo	Very low with high uncertainty
Risk of introduction of H5N1 into Ghana via contaminated poultry workers in Togo	Very low with high uncertainty
Risk of introduction of H5N1 into Ghana via contaminated anchovies in Togo	Negligible with high uncertainty
Risk of introduction of H5N1 into Ghana via contaminated frozen turkey tails and poultry carcasses imported into Togo and re-exported into Ghana	Negligible with high uncertainty
Risk of introduction of H5N1 into Ghana via contaminated vehicles during outbreak in Togo	Negligible with medium uncertainty

Overall, the risk of introduction of H5N1 into Ghana from Togo ranged from Negligible to Very low with high uncertainty.

There was absence of reliable data as none of the people in Togo contacted responded and the information provided by a respondent had low confidence levels as they were entirely based on his opinion.

The steps of the pathway for introduction of HPAI from Togo to Ghana associated with higher risks were:

- the probability of introducing live household birds
- the probability of contamination of poultry workers
- the probability of anchovies being obtained from Togo for use in poultry feeding
- the probability that frozen turkey tails and some poultry carcasses found in Ghana are from Togo
- the probability of vehicles from Togo visiting Ghana

Recommendation

There is regular trade flow to and out of Ghana on market days in markets near border towns in both countries making control of movement of poultry, poultry products, fomites and people near to impossibility without trans-boundary co-ordinated prevention and control measures. It is necessary to institute cross-border control activities to mitigate the identified potential threats.

5. Risk Assessment for Exposure and Consequences

The Veterinary Services Directorate's major interest was risk assessment for release resulting from re-introduction of the HPAI H5N1 virus from the neighbouring countries. Therefore, risk assessment for exposure and consequences was not considered.

6. Overall summary and recommendations

The overall risk of introduction of HPAI H5N1 into Ghana from the neighbouring countries ranged from negligible to medium (high uncertainty) for Cote d'Ivoire, and from negligible to low or very low (high uncertainty) for Burkina Faso and Togo. This is likely to vary when there is an outbreak in a neighbouring country because of increase in the risks of infection or contamination. It was difficult ranking the pathways from each of these countries by risk estimates because they were very similar to a large extent. Table 6.1 provides a summary.

Table 6.1: Summary conclusions from risk of re-introduction of HPAI H5N1 virus from neighbouring countries into Ghana via cross-border trade and movement of birds and people

Release Risk Pathway	Probability	Uncertainty
Risk of re-introduction of HPAI H5N1 virus from Cote d'Ivoire	Negligible to medium	High
Risk of re-introduction of HPAI H5N1 virus from Burkina Faso	Negligible to low	High
Risk of re-introduction of HPAI H5N1 virus from Togo	Negligible to very low	High

The high level of uncertainty associated with most of the risk estimates point to significant gaps in the knowledge of the epidemiology of HPAI in West Africa. Therefore, the risk estimates have to be interpreted with extreme caution. There is the need for targeted data collection to fill some of the relevant knowledge gaps. The particular areas are the prevalence of HPAI in the wild and scavenging birds, movement patterns of people and poultry and poultry products across the borders.

The steps associated with higher risks for introduction of HPAI H5N1 virus into Ghana which could be considered as targets for preventive cross-border measures in cases of new outbreaks in neighbouring countries are:

Côte d'Ivoire

- The probability of introduction of live birds. To control this, there is the need to strictly enforce the ban on importation of poultry and poultry products from countries that had had outbreaks of HPAI. Surveillance measures along the border will need to be enhanced. The presence of farms across the borders belonging to same families presents as a peculiar problem. The owners will need to be educated on the essence of strict separation of activities and also bio-security measures to reduce the risks of outbreaks.

- The probability of introduction of eggs and egg trays. Similar to above, there is need for enforcement of bans on importation of eggs and egg trays. Traders ought to be educated on the risks in importing these into Ghana, especially through unapproved routes.

- The probability of introduction of DOC. This can be controlled by effective surveillance of borders and education of traders and farmers on the risk of infection from such sources.

- The probability of contamination of traders. This can be prevented within CI by the requirement for institutionalisation of bio-security measures and procedures on farms. This aspect is beyond the control of VSD in Ghana.

- The probability of contamination of poultry workers on small farms. Again, the institutionalisation and enforcement of bio-security measures and procedures on farms in CI will prevent workers from being contaminated. This aspect is beyond the control of VSD in Ghana.

Burkina Faso

- The probability of introducing live household birds. This can be controlled by effective surveillance of borders and education of people living along the borders and farmers on the risk of infection from such sources. This calls for cross-border communication strategies to effectively disseminate information as recommended by the CVO's in Annex 6.

- The probability of transporting guinea fowl eggs. There is need for enforcement of bans on importation of eggs and egg trays. Traders ought to be educated on the risks in importing these into Ghana, especially through unapproved routes.

- The probability of contamination of baskets and egg containers. Baskets and egg containers that cannot be disinfected should be banned from being used.

- The probability of transporting baskets and egg containers. Baskets and egg containers that cannot be disinfected should not be allowed into the Ghana and specifically markets. This calls for enhanced surveillance at all times.

- The probability of traders using vehicles to markets. Traders using vehicles should have these vehicles disinfected at the borders and also before being allowed into markets.

- The probability of maize being imported for use in poultry feeding in Ghana. Farmers should be educated not to use maize from unknown sources for feed formulation.

Togo

- The probability of introducing live household birds. This can be controlled by effective surveillance of borders and education of people living along the borders and farmers on the risk of infection from such sources. This calls for cross-border communication strategies to effectively disseminate information as recommended by the CVO's in Annex 6.

- The probability of contamination of poultry workers. The institutionalisation and enforcement of bio-security measures and procedures on farms in Togo will prevent workers from being contaminated. This aspect is beyond the control of VSD in Ghana.

- The probability of anchovies being obtained from Togo for use in poultry feeding. There is the need for farmers to be educated on not to use anchovies from unknown sources for feed formulation.

- The probability that frozen turkey tails and carcasses found in Ghana are from Togo. There is the need for effective surveillance, seizure and prosecution of importers of these products since officially these are banned. The continued importation points to ineffective control.
- The probability of vehicles from Togo visiting Ghana. This is beyond VSD. However, during outbreaks, VSD has instituted vehicle disinfection procedures at the borders.

The involvement of the neighbouring countries is critical to effective prevention and control measures on regional basis, rather than on individual country-basis, as illustrated above. This formed the basis of an establishment of West African CVOs Consultative meetings to harmonise prevention and control measures across West Africa for effective control of HPAI. There have been 3 cross border meetings at Sunyani, Ghana (June 2007), Agbodrafo, Togo (November 2007) and Abidjan, Cote d'Ivoire (September 2008). Recommendations from one of the meetings are attached as Annex 6. They elaborate on specific preventive and control measures that can be done and emphasise the need for harmonisation of policies and measures for effectiveness.

7. Conclusions

The qualitative risk assessment set out to estimate the risk of re-introduction of HPAI H5N1 virus from neighbouring countries into Ghana via cross-border trade and movement of birds and people. We identified three risk pathways originating from Cote d'Ivoire, Burkina Faso and Togo. The overall risk release estimates ranged from negligible to medium with uncertainty being high.

The critical control or mitigation point is an effective control at the border. The steps identified as having higher risks should be targeted for control at the borders or in collaboration with the neighbouring countries in co-ordinated cross-border measures. The porous nature at the borders with many unapproved entry routes makes this daunting and challenging. This calls for co-ordination of control measures across borders at a regional level (West Africa) if this is to be effective.

The dearth of data or information presents a challenge to a reliable estimation of risks and more work is needed to improve the credibility of information received for the assessment. At the moment, a quantitative risk analysis is not recommended.

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Annexes

Annex 1: List of Participants at Ghana Workshop

List of Participants

Workshop

Pro-Poor HPAI Risk Reduction Strategies Research Project:

Risk Pathways for HPAI in Ghana

November 25-27, 2008

Accra, Ghana

Facilitators: Paulo Duarte, Raphaëlle Métras and Paa Kobina Turkson

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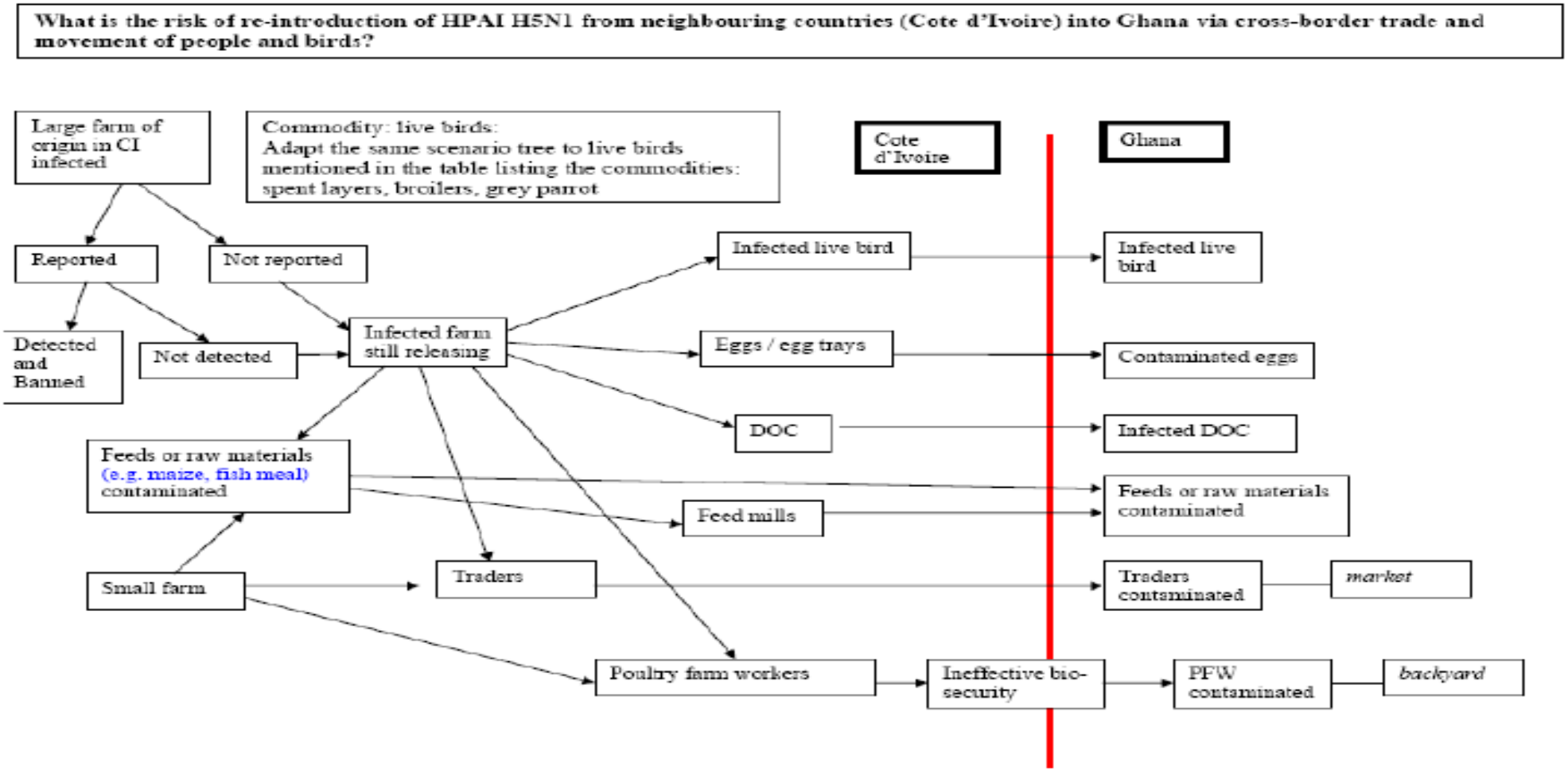
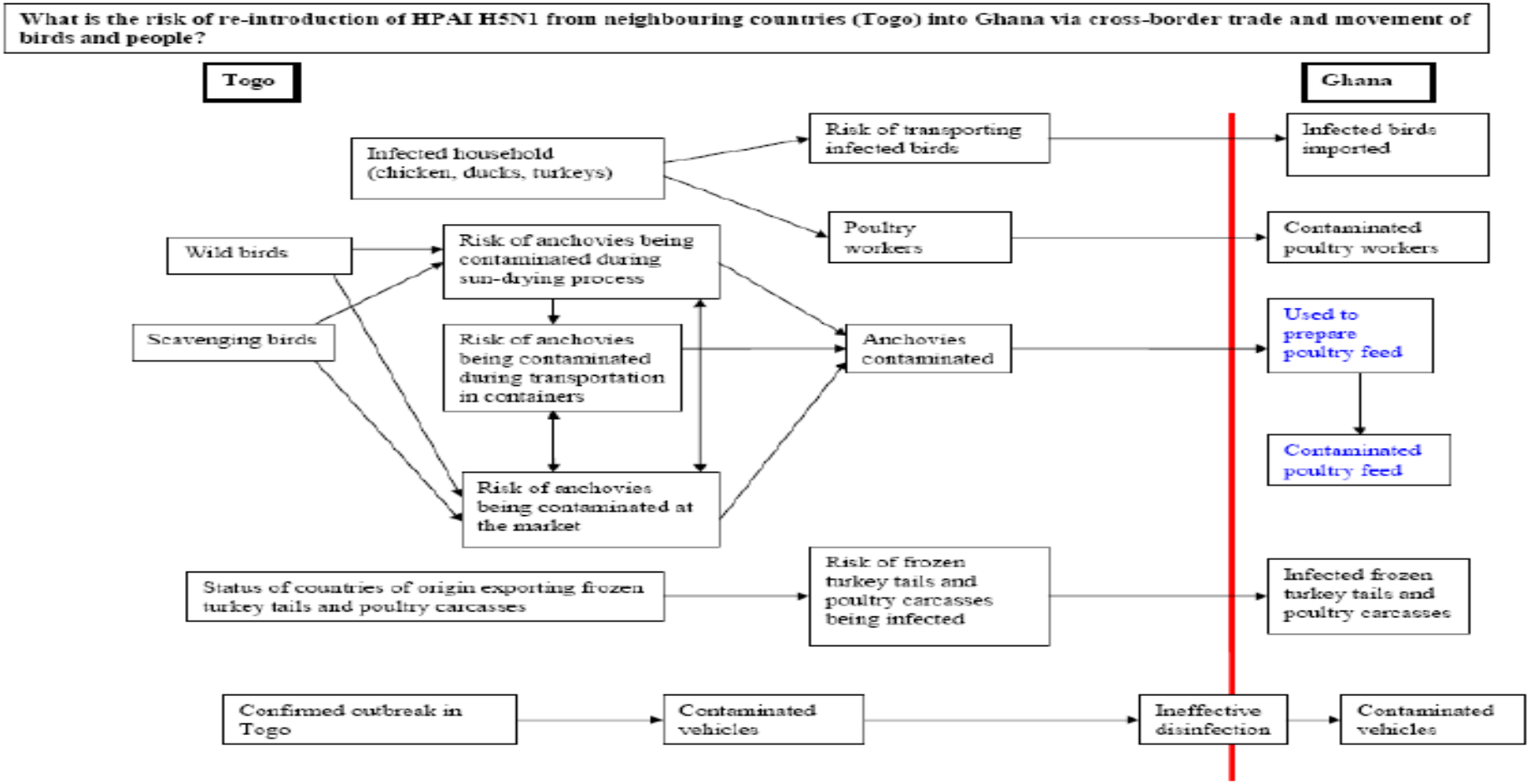
Annex 2: Risk questions from Ghana Workshop

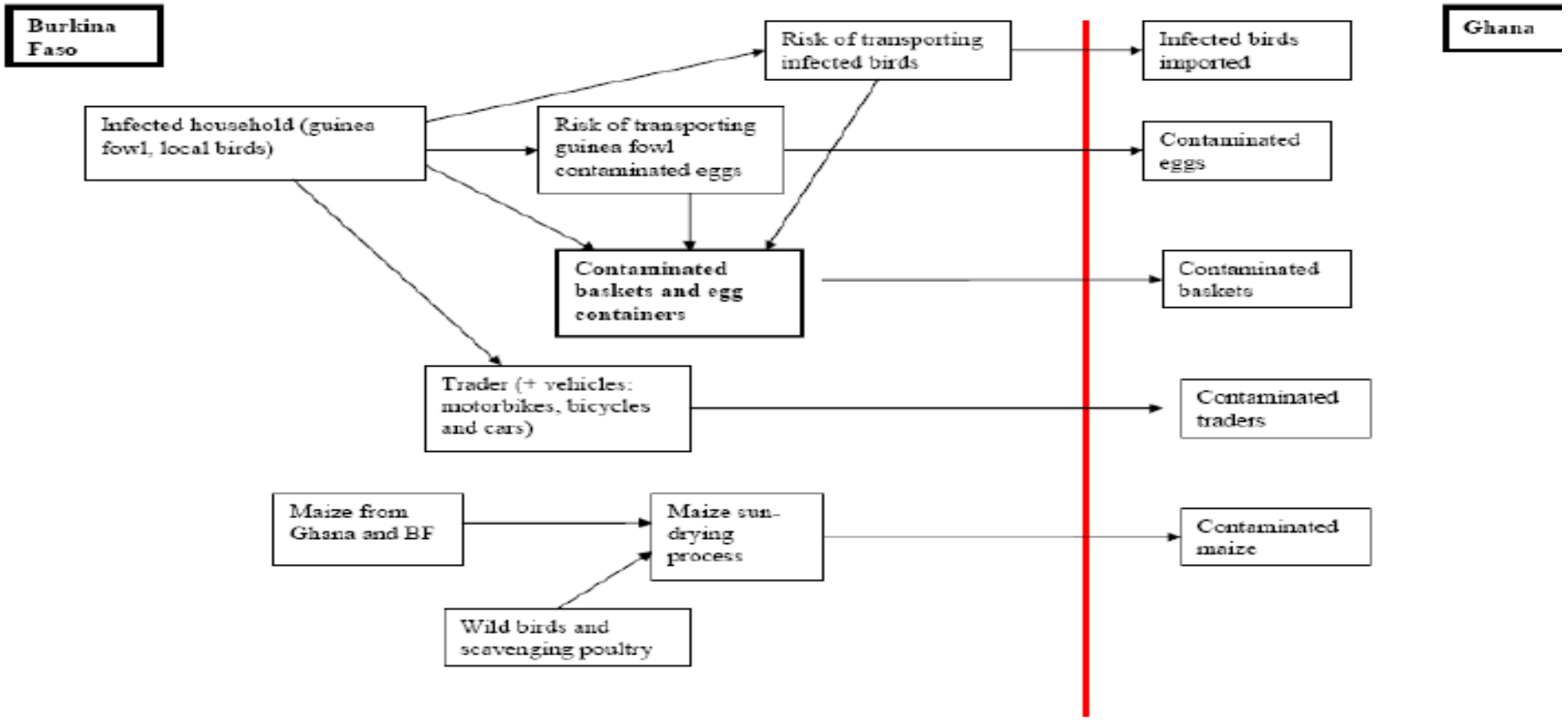
Risk questions – Introduction of HPAI H2N1 into Ghana	Rank
What is the risk of re-introduction of HPAI H5N1 from neighbouring countries into Ghana via cross-border trade? Live birds, poultry products, fomites. (Burkina Faso, Cote d'Ivoire, Togo)	**1**
What is the risk of re-introduction of HPAI into Ghana through wild birds?	
What is the risk of re-introduction of HPAI H5N1 from importation of poultry products?	
Risk questions – Transmission within Ghana	
What is the risk of transmission of H5N1 between small scale farms and backyard/rural?	
What is the risk of transmission of H5N1 between small scale farms and large scale farms?	
What is the risk of transmission of H5N1 between backyard and large scale farms?	
What is the risk of transmission of H5N1 within backyard/rural?	
What is the risk of transmission of H5N1 within small scale commercial farms? Live birds, poultry products, fomites.	**2**
What is the risk of transmission of H5N1 within large scale farms?	
What is the risk transmission of H5N1 through fomites between sectors farms?	

Annex 3: Release Pathways




What is the risk of re-introduction of HPAI H5N1 from neighbouring countries (Togo) into Ghana via cross-border trade and movement of birds and people?
Togo
Ghana
Infected household (chicken, ducks, turkeys)
Risk of transporting infected birds
Infected birds imported
Poultry workers
Contaminated poultry workers
Wild birds
Risk of anchovies being contaminated during sun-drying process
Scavenging birds
Risk of anchovies being contaminated during transportation in containers
Anchovies contaminated
Used to prepare poultry feed
Contaminated poultry feed
Risk of anchovies being contaminated at the market
Status of countries of origin exporting frozen turkey tails and poultry carcasses
Risk of frozen turkey tails and poultry carcasses being infected
Infected frozen turkey tails and poultry carcasses
Confirmed outbreak in Togo
Contaminated vehicles
Ineffective disinfection
Contaminated vehicles

What is the risk of re-introduction of HPAI H5N1 from neighbouring countries (Burkina) into Ghana via cross-border trade and movement of birds and people?



Annex 4: Questionnaires for Data Collection

QUALITATIVE RISK ASSESSMENT: QUESTIONNAIRES FOR GHANA
EVALUATION DU RISQUE QUALITATIF: QUESTIONNAIRES DU GHANA

COTE D'IVOIRE

Information on the respondents:/Information sur les personnes remplissant le questionnaire

Affiliation/Institution: _____

Position of respondent _____

Poste occupé par la personne remplissant le questionnaire

Expertise of the respondent _____

Spécialité / domaine d'expertise de la personne remplissant le questionnaire

Date: _____

Structure of the questionnaire:

This questionnaire consists of successive parts, each corresponding to a risk pathway for re-introduction of Avian Influenza into Ghana.

Structure du questionnaire:

Le questionnaire est composé de différentes sections, chacune correspondant a un mécanisme de réintroduction de l'Influenza Aviaire (AI) au Ghana.

Instructions :

L'institution sollicitée doit rendre un seul questionnaire : les différentes personnes participant à remplir le questionnaire doivent s'accorder sur une seule et même réponse par question.

Côte d'Ivoire (CI)

Question	**Confidence in your answer** Indicate how confident you are in your answer (1=not confident; 5=very confident) (Tick the appropriate box) **Niveau de confiance accordée a la réponse (indiquer ce niveau de confiance de 1 à 5 : 1= pas confiant, 5= très confiant)**	Indicate whether your answer is based on **Opinion**, **Observation** or **Data.** *If based on data, please indicate source.* **Préciser si votre réponse est basée sur une opinion, une observation ou sur des données (dans le cas des données, indiquez la source)**
1. What was the poultry population in CI in 2007? Answer: **1. Quelle était la taille de la population avicole (volailles) en CI en 2007?** **Réponse :**	☐ 1 ☐ 2 ☐ 3 ☐ 4 ☐ 5	
2. What proportion of poultry farms in CI in 2007 could be described as large farms (farms with 10,000-20,000 birds)? Answer: **2. En 2007 en CI, quelle proportion de ferme avicole était représentée par des larges exploitations commerciales (LEC) (entre 10 000 et 20 000 volailles) ?** **Réponse :**	☐ 1 ☐ 2 ☐ 3 ☐ 4 ☐ 5	
3. What proportion of large farms experienced an outbreak in 2006 in CI? Answer: **3. Dans quelle proportion les LEC ont-elles reporté un cas de grippe aviaire en CI, en 2006 ?** **Réponse :**	☐ 1 ☐ 2 ☐ 3 ☐ 4 ☐ 5	

4. What was the average prevalence of HPAI within large farms in CI in 2006? Answer: **4. Dans les LEC, quelle était la prévalence moyenne de l'Influenza Aviaire, en CI en 2006?** **Réponse :**	☐ 1 ☐ 2 ☐ 3 ☐ 4 ☐ 5	
5. Where are the large farms in CI located? Answer: **5. Où sont localisées les LEC en CI?** **Réponse :**	☐ 1 ☐ 2 ☐ 3 ☐ 4 ☐ 5	
6. What proportion of large farms in CI is located within 100km of the border with Ghana? Answer: **6. Quelle proportion de LEC en CI sont situées a moins de 100 km de la frontière avec le Ghana ?** **Réponse :**	☐ 1 ☐ 2 ☐ 3 ☐ 4 ☐ 5	
7. What proportion of large farms in CI produced live birds in 2007? Answer: **7. En 2007, quelle proportion de LEC en CI produisait des volailles vivantes ?** **Réponse :**	☐ 1 ☐ 2 ☐ 3 ☐ 4 ☐ 5	
8. What proportion of large farms in CI produced egg in 2007? Answer: **8. En 2007, quelle proportion de LEC en CI produisait des œufs ?** **Réponse :**	☐ 1 ☐ 2 ☐ 3 ☐ 4 ☐ 5	
9. What proportion of large farms in CI produced day-old-chicks in 2007? Answer: **9. En 2007, quelle proportion de LEC en CI produisait des poussins de un jour?** Réponse :	☐ 1 ☐ 2 ☐ 3 ☐ 4 ☐ 5	
10. What types of birds were exported from CI into Ghana in 2007? Answer: **10. Quel type de volailles était exporté au Ghana depuis la CI en 2007?** **Réponse :**	☐ 1 ☐ 2 ☐ 3 ☐ 4 ☐ 5	

11. What was the volume of live birds exported from CI to Ghana in 2007? **11. Quelle quantité de volailles vivantes a été exportée de la CI au Ghana en 2007?** **Réponse :**	☐ 1 ☐ 2 ☐ 3 ☐ 4 ☐ 5	
12. Where are the entry points of live birds into Ghana from CI? Answer: **12. Quels sont les points d'entrée géographique de volailles vivantes au Ghana depuis la CI?** **Réponse :**	☐ 1 ☐ 2 ☐ 3 ☐ 4 ☐ 5	
13. What was the volume of eggs exported from CI to Ghana in 2007? Answer: **13. Quelle quantité d'œufs a été exportée de la CI au Ghana en 2007?** **Réponse :**	☐ 1 ☐ 2 ☐ 3 ☐ 4 ☐ 5	
14. Where are the entry points of eggs into Ghana from CI? Answer: **14. Quels sont les points d'entrée géographique d'oeufs au Ghana depuis la CI?** **Réponse :**	☐ 1 ☐ 2 ☐ 3 ☐ 4 ☐ 5	
15. What was the volume of day-old chicks exported from CI to Ghana in 2007? **15. Quelle quantité des poussins de un jour a été exportée de la CI au Ghana en 2007?** **Réponse :**	☐ 1 ☐ 2 ☐ 3 ☐ 4 ☐ 5	
16. Where are the entry points of day-old chicks into Ghana from CI? Answer: **16. Quels sont les points d'entrée géographique des poussins de un jour au Ghana depuis la CI?** **Réponse :**	☐ 1 ☐ 2 ☐ 3 ☐ 4 ☐ 5	
17. What were the origins of day-old chicks or parent stock of birds exported from CI into Ghana in 2007? Answer: **17. Quelle(s) étaient l'origine(s) des poussins de un jour ou des reproducteur parent des volailles exportées depuis la CI vers le Ghana en 2007 ?** **Réponse :**	☐ 1 ☐ 2 ☐ 3 ☐ 4 ☐ 5	

18. What types and volumes of feeds or raw materials for poultry feed were exported from CI into Ghana in 2007? Answer: **18. Quel type et quelle quantité d'aliments pour volailles ou de matières premières ont été exportés depuis la CI vers le Ghana en 2007 ?** **Réponse :**	☐ 1 ☐ 2 ☐ 3 ☐ 4 ☐ 5	
19. How many poultry feed mills were there in CI in 2007? Answer: **19. Combien y avait-il d'usines (ou fabrique) à aliment pour volailles en CI en 2007?** **Réponse :**	☐ 1 ☐ 2 ☐ 3 ☐ 4 ☐ 5	
20. What proportion of poultry farms in CI used feed mills in 2007? Answer: **20. Quelle proportion de ferme de volailles en CI frequente les usines (ou fabrique) à aliment pour volailles ?** **Réponse :**	☐ 1 ☐ 2 ☐ 3 ☐ 4 ☐ 5	
21. How many egg traders were there in CI in 2007? Answer: **21. Combien de commerçants d'œufs y avait-il en CI en 2007?** **Réponse :**	☐ 1 ☐ 2 ☐ 3 ☐ 4 ☐ 5	
22. How many spent layer traders were there in CI in 2007? Answer: **22. Combien de pondeuses reformées y avait-il en CI en 2007 ?** **Réponse :**	☐ 1 ☐ 2 ☐ 3 ☐ 4 ☐ 5	
23. What proportion of egg traders in CI visited Ghana in 2007 in a month? **23. En 2007, par mois, quelle proportion de commerçants d'œufs de CI entrait au Ghana?** **Réponse :**	☐ 1 ☐ 2 ☐ 3 ☐ 4 ☐ 5	
24. What proportion of spent layer traders in CI visited Ghana in 2007 in a month? Answer: **24. En 2007, par mois, quelle proportion de commerçant de pondeuses reformées de CI entrait au Ghana ?** **Réponse :**	☐ 1 ☐ 2 ☐ 3 ☐ 4 ☐ 5	

25. How many poultry farm workers were there in CI in 2007? Answer: **25. En 2007, combien y avait-il de personnes en CI travaillant dans les fermes avicoles ?** **Réponse :**	☐ 1 ☐ 2 ☐ 3 ☐ 4 ☐ 5	
26. What proportion of poultry farm workers worked on small farms (farms with 2000-5000 birds) in 2007? Answer: **26. Parmi ces personnes travaillant dans les fermes avicoles, quelle proportion travaillait dans des petites exploitations (PE) (2000- 5000 volailles) en 2007 ?** **Réponse :**	☐ 1 ☐ 2 ☐ 3 ☐ 4 ☐ 5	
27. What proportion of small farm poultry workers in CI visited Ghana in a month in 2007? Answer: **27. En 2007, par mois, quelle proportion d'employés de PE en CI entrait au Ghana?** **Réponse :**	☐ 1 ☐ 2 ☐ 3 ☐ 4 ☐ 5	
28. Where are the entry points for small farm poultry workers visiting Ghana? Answer: **28. Par où les employés de PE de CI entrent-ils au Ghana (points d'entrée)?** **Réponse :**	☐ 1 ☐ 2 ☐ 3 ☐ 4 ☐ 5	
29. What are the disinfection procedures on farms with workers who visit Ghana frequently? Answer: **29. Quelles procédures de désinfection existent pour les employés des PE qui vont fréquemment au Ghana?** **Réponse :**	☐ 1 ☐ 2 ☐ 3 ☐ 4 ☐ 5	

QUALITATIVE RISK ASSESSMENT: QUESTIONNAIRES FOR GHANA
EVALUATION DU RISQUE QUALITATIF: QUESTIONNAIRES DU GHANA

BURKINA FASO

Information on the respondents:/Information sur les personnes remplissant le questionnaire

Affiliation/Institution: _____

Position of respondent _____

Poste occupé par la personne remplissant le questionnaire

Expertise of the respondent _____

Spécialité / domaine d'expertise de la personne remplissant le questionnaire

Date: _____

Structure of the questionnaire:

This questionnaire consists of successive parts, each corresponding to a risk pathway for re-introduction of Avian Influenza into Ghana.

Structure du questionnaire:

Le questionnaire est composé de différentes sections, chacune correspondant a un mécanisme de réintroduction de l'Influenza Aviaire (AI) au Ghana.

Instructions :

L'institution sollicitée doit rendre un seul questionnaire : les différentes personnes participant à remplir le questionnaire doivent s'accorder sur une seule et même réponse par question.

Burkina Faso (BF)

Question	**Confidence in your answer** (Indicate , using a number from 1-5 how confident you are in your answer (1=not confident; 5=very confident) **Niveau de confiance accordée a la réponse (indiquer ce niveau de confiance de 1 à 5 : 1= pas confiant, 5= très confiant)**	Indicate whether your answer is based on **Opinion, Observation** or **Data**. *If based on data, please indicate source.* **Préciser si votre réponse est basée sur une opinion, une observation ou sur des données (dans le cas des données, indiquez la source)**
1. What was the poultry population in Burkina Faso in 2007? Answer: **1. Quelle était la taille de la population avicole (volailles) au Burkina Faso (BF) en 2007?** **Réponse :**	☐ 1 ☐ 2 ☐ 3 ☐ 4 ☐ 5	
2. What proportion of poultry in BF in 2007 was kept in households? Answer: **2 . Quelle proportion de volailles au BF est élevée en basse-cour (à la maison)?** **Réponse :**	☐ 1 ☐ 2 ☐ 3 ☐ 4 ☐ 5	
3. What are the species and proportions of household birds in BF? Answer: **3. Au BF, quelles espèces de volailles sont élevées en basse-cour ?** **Réponse :**	☐ 1 ☐ 2 ☐ 3 ☐ 4 ☐ 5	
4. What was the volume of guinea fowls exported from BF to Ghana in 2007? **4. Combien de pintades ont été exportées du BF au Ghana en 2007?** **Réponse :**	☐ 1 ☐ 2 ☐ 3 ☐ 4 ☐ 5	
5. What was the volume of local birds exported from BF to Ghana in 2007? **5. Combien de volailles (d'espèces locales) ont été exportées du BF au Ghana en 2007 ?** **Réponse :**	☐ 1 ☐ 2 ☐ 3 ☐ 4 ☐ 5	

6. What was the prevalence of Avian Influenza in guinea fowls or local birds in BF in 2006 when there was an outbreak? Answer: **6. Quelle était la prévalence de l'Influenza Aviaire chez les pintades ou les volailles locales au BF en 2006 pendant la période de cas de grippe aviaire ?** **Réponse :**	☐ 1 ☐ 2 ☐ 3 ☐ 4 ☐ 5	
7. How frequent are guinea fowls or local birds transported from BF into Ghana? **(Tick one)** **7. A quelle fréquence les pintades ou les volailles locales sont-elles transportées du BF au Ghana ? (cochez une seule case)** **Réponse: tous les jours ☐ une fois par semaine ☐ une fois par mois ☐**	☐ 1 ☐ 2 ☐ 3 ☐ 4 ☐ 5	
8. Where are the entry points for importation of guinea fowls and local birds from BF into Ghana? Answer: **8. Quels sont les points d'entrée géographique pour l'importation de pintades et de volailles locales au Ghana depuis le BF?** **Réponse :**	☐ 1 ☐ 2 ☐ 3 ☐ 4 ☐ 5	
9. What are the travel times (in days?) for guinea fowls or local birds from markets in BF to Ghana border towns? **9. Quelle est la durée de transport - moyenne, minimum et maximum (en jours?)- des pintades ou volailles locales, entre leur point de départ au BF et leur arrivée dans les villes frontalières du Ghana ?** **Réponse : Moyenne _____Minimum _____Maximum _____**	☐ 1 ☐ 2 ☐ 3 ☐ 4 ☐ 5	
10. What was the volume of guinea fowl eggs exported from BF into Ghana in 2007? Answer **10. Combien d'œufs de pintades ont été exportés du BF vers le Ghana en 2007?** **Réponse :**	☐ 1 ☐ 2 ☐ 3 ☐ 4 ☐ 5	
11. What is the frequency of importation of guinea fowl eggs from BF into Ghana in 2007? (Tick one) **11. A quelle fréquence les oeufs de pintades ont été exportés du BF vers le Ghana en 2007? (cochez une seule case)** **Réponse: tous les jours ☐ une fois par semaine ☐ une fois par mois ☐**	☐ 1 ☐ 2 ☐ 3 ☐ 4 ☐ 5	

12. What are the travel times (in days?) for guinea fowl eggs from markets in BF to Ghana border towns? **12. Quelle est la durée de transport - moyenne, minimum et maximum (en jours ?)- des œufs de pintades entre leur marché au BF et leur arrivée dans les villes frontalières du Ghana ?** **Réponse : Moyenne _____Minimum _____Maximum _____**	☐ 1 ☐ 2 ☐ 3 ☐ 4 ☐ 5	
13. What are the types and capacities of containers/carriers used for guinea fowls? Answer: **13. Dans quoi les pintades sont-elles transportées (type de container et volume)?** **Réponse :**	☐ 1 ☐ 2 ☐ 3 ☐ 4 ☐ 5	
14. How often are these carriers/containers used / re-used before discarding? **14. Combien de fois ces containers sont-ils utilisés avant d'être jetés?** **Réponse :**	☐ 1 ☐ 2 ☐ 3 ☐ 4 ☐ 5	
15. What are the types and capacities of containers/carriers used for guinea fowl eggs? Answer: **15. Dans quoi ces œufs de pintades sont-ils transportés (type de container et volume)?** **Réponse :**	☐ 1 ☐ 2 ☐ 3 ☐ 4 ☐ 5	
16. How often are these carriers/containers used or re-used before discarding? **16. Combien de fois ces containers sont-ils utilisés avant d'être jetés?** **Réponse :**	☐ 1 ☐ 2 ☐ 3 ☐ 4 ☐ 5	
17. How many guinea fowl traders were there in BF in 2007? Answer: **17. Combien de commerçants de pintades y avait-il au BF en 2007?** **Réponse :**	☐ 1 ☐ 2 ☐ 3 ☐ 4 ☐ 5	
18. What proportion of guinea fowl traders visit Ghana in one month? Answer: **18. Par mois, quelle proportion de ces commerçants de pintades vont au Ghana ?** **Réponse :**	☐ 1 ☐ 2 ☐ 3 ☐ 4 ☐ 5	

19. Where are the entry points of guinea fowl traders from BF into Ghana? **10. Par où ces commerçants de pintades du BF entrent-ils au Ghana (points d'entrée)?** **Réponse :**	☐ 1 ☐ 2 ☐ 3 ☐ 4 ☐ 5	
20. What was the volume of maize imported to Ghana from BF in 2007? **20. Quelle quantité de maïs a été importée au Ghana depuis le BF en 2007?** **Réponse :**	☐ 1 ☐ 2 ☐ 3 ☐ 4 ☐ 5	
21. What proportion of maize in BF is dried in the sun? Answer: **21. Quelle proportion du maïs au BF est séchée au soleil?** **Réponse :**	☐ 1 ☐ 2 ☐ 3 ☐ 4 ☐ 5	
22. What are the minimum, maximum and average lengths of time (days) for sun-drying of maize in BF? **22. Quelle est la durée moyenne, minimum et maximum (en jours) du processus de séchage au soleil du maïs au BF?** **Réponse : Moyenne _____Minimum _____Maximum _____**	☐ 1 ☐ 2 ☐ 3 ☐ 4 ☐ 5	
23. What was the prevalence of Avian Influenza in wild and scavenging birds in BF in 2006 when there was an outbreak? Answer: **23. Quelle était la prévalence de l'Influenza aviaire au BF chez les oiseaux sauvages et les oiseaux errants en 2006, lors des cas de grippe aviaire?** **Réponse :**	☐ 1 ☐ 2 ☐ 3 ☐ 4 ☐ 5	

QUALITATIVE RISK ASSESSMENT: QUESTIONNAIRES FOR GHANA
EVALUATION DU RISQUE QUALITATIF: QUESTIONNAIRES DU GHANA

TOGO

Information on the respondents:/Information sur les personnes remplissant le questionnaire

Affiliation/Institution: _____

Position of respondent _____

Poste occupé par la personne remplissant le questionnaire

Expertise of the respondent _____

Spécialité / domaine d'expertise de la personne remplissant le questionnaire

Date: _____

Structure of the questionnaire:

This questionnaire consists of successive parts, each corresponding to a risk pathway for re-introduction of Avian Influenza into Ghana.

Structure du questionnaire:

Le questionnaire est composé de différentes sections, chacune correspondant a un mécanisme de réintroduction de l'Influenza Aviaire (AI) au Ghana.

Instructions :

L'institution sollicitée doit rendre un seul questionnaire : les différentes personnes participant à remplir le questionnaire doivent s'accorder sur une seule et même réponse par question.

Togo

Question	**Confidence in your answer** (Indicate , using a number from 1-5 how confident you are in your answer (1=not confident; 5=very confident) **Niveau de confiance accordée a la réponse (indiquer ce niveau de confiance de 1 à 5 : 1= pas confiant, 5= très confiant)**	Indicate whether your answer is based on **Opinion**, **Observation** or **Data**. *If based on data, please indicate source.* **Préciser si votre réponse est basée sur une opinion, une observation ou sur des données (dans le cas des données, indiquez la source)**
1. What was the poultry population in Togo in 2007? Answer: **1. Quelle était la taille de la population avicole (volailles) au Togo en 2007?** **Réponse :**	☐ 1 ☐ 2 ☐ 3 ☐ 4 ☐ 5	
2. What proportion of poultry in Togo is kept in households? Answer: **2. Quelle proportion de volailles au Togo est élevée en basse-cour (à la maison)?** **Réponse :**	☐ 1 ☐ 2 ☐ 3 ☐ 4 ☐ 5	
3. What species of birds are kept by households in Togo? Answer: **3. Au Togo, quelles espèces de volailles sont élevées en basse-cour ?** **Réponse :**	☐ 1 ☐ 2 ☐ 3 ☐ 4 ☐ 5	
4. What is the volume of household birds exported from Togo to Ghana annually? Answer: **4 Quelle quantité de volailles de basse-cour est exportée du Togo vers le Ghana chaque année?** **Réponse :**	☐ 1 ☐ 2 ☐ 3 ☐ 4 ☐ 5	
5. How frequently are household birds exported from Togo to Ghana? **(Tick one)** **Answer:** Daily ☐ Weekly ☐ Monthly ☐ **5.A quelle fréquence les volailles de basse-cour sont-elles exportées du Togo vers le Ghana ?** **Réponse: tous les jours** ☐ **une fois par semaine** ☐ **ne fois par mois** ☐	☐ 1 ☐ 2 ☐ 3 ☐ 4 ☐ 5	

6. Where are the entry points for importation of household birds into Ghana? **Answer:** **6. Quels sont les points d'entrée géographique pour l'importation de volailles de volailles de basse-cour vers le Ghana depuis le Togo?** **Réponse :**	☐ 1 ☐ 2 ☐ 3 ☐ 4 ☐ 5	
7. What are the travel times (**in days**) for transporting household birds from points of origin in Togo to border towns in Ghana? Answer: Average _____ Minimum_____ Maximum _____ **7. Quels sont les temps de transport - moyen, minimum et maximum (en jours) - des volailles de basse-cour entre leur point de départ au Togo et leur arrivée dans les villes frontalières du Ghana ?** **Réponse : Moyenne_____Minimum_____Maximum**	☐ 1 ☐ 2 ☐ 3 ☐ 4 ☐ 5	
8. How many poultry farm workers were there in Togo in 2007? Answer: **8. En 2007, combien y avait-il de personnes au Togo travaillant dans les fermes avicoles ?** **Réponse :**	☐ 1 ☐ 2 ☐ 3 ☐ 4 ☐ 5	
9. What proportion of poultry farm workers in Togo visit Ghana in a month? Answer: **9. En 2007, par mois, parmi les employés de fermes avicoles au Togo, quelle proportion entrait au Ghana ?** **Réponse :**	☐ 1 ☐ 2 ☐ 3 ☐ 4 ☐ 5	
10. Where are the points of entry of poultry farm workers into Ghana? Answer: **10. Par où les employés de PE de CI entrent-ils au Ghana (points d'entrée)?** **Réponse :**	☐ 1 ☐ 2 ☐ 3 ☐ 4 ☐ 5	
11. What was the volume of anchovies exported from Togo to Ghana in 2007? Answer: **11. Quelle quantité d'anchois était exportée du Togo au Ghana en 2007?** **Réponse :**	☐ 1 ☐ 2 ☐ 3 ☐ 4 ☐ 5	

12. What are the average, minimum and maximum length of sun-drying time for anchovies sold on Togo markets? **12. Quelle est la durée moyenne, minimum et maximum du processus de séchage au soleil des anchois destinés à être vendus sur les marchés au Togo ?** **Reponse : Moyenne_____Minimum_____Maximum**	☐ 1 ☐ 2 ☐ 3 ☐ 4 ☐ 5	
13. What was the prevalence of Avian Influenza in wild birds in Togo in 2007? Answer: **13. En 2007, quelle était la prévalence de la grippe aviaire chez les oiseaux sauvages au Togo?** **Réponse** :	☐ 1 ☐ 2 ☐ 3 ☐ 4 ☐ 5	
14. What proportion of anchovies sold in Togo markets is sun-dried? Answer: **14. Quelle proportion d'anchois vendus sur les marchés au Togo a subi le processus de séchage au soleil?** **Réponse :**	☐ 1 ☐ 2 ☐ 3 ☐ 4 ☐ 5	
15. What types of packaging are used in transporting anchovies? Answer: **15. Quel type d'emballage est utilisé pour transporter les anchois?** **Réponse :**	☐ 1 ☐ 2 ☐ 3 ☐ 4 ☐ 5	
16. What are the travel times (in days?) for transporting anchovies from points of origin in Togo to border towns in Ghana? **16. Quelle est la durée de transport - moyenne, minimum et maximum (en jours ?)- des anchois séchés au soleil, entre leur point de départ au Togo et leur arrivée dans les villes frontalières du Ghana ?** **Réponse : Moyenne_____Minimum_____Maximum _____**	☐ 1 ☐ 2 ☐ 3 ☐ 4 ☐ 5	
17. Where do most of the anchovies on Togo market come from (locality)? Answer: **17. D'où viennent la plupart des anchois que l'on trouve sur les marchés au Togo (localité) ?** **Réponse :**	☐ 1 ☐ 2 ☐ 3 ☐ 4 ☐ 5	

18. What proportion of anchovies exported to Ghana is obtained from markets in Togo? Answer: **18. Quelle proportion d'anchois exportés au Ghana provient des marchés togolais?** **Réponse :**	☐ 1 ☐ 2 ☐ 3 ☐ 4 ☐ 5	
19. Is there adulteration of anchovies sold at markets in Togo? If yes, with what? Answer: **19. Les anchois vendus sur le marchés au Togo sont-ils mélangés avec du sable ou autre ? Si oui, avec quoi ?** **Réponse :**	☐ 1 ☐ 2 ☐ 3 ☐ 4 ☐ 5	
20. What was the volume of frozen turkey tails imported into Togo in 2007? **20. Quel volume de queue de dinde congelée (QDC) a été importé en 2007 au Togo ?** **Réponse :**	☐ 1 ☐ 2 ☐ 3 ☐ 4 ☐ 5	
21. What proportion of these frozen turkey tails might have found its way into Ghana? Answer: **21. Quelle proportion de ces QDC aurait pu être destinée au Ghana ?** **Réponse :**	☐ 1 ☐ 2 ☐ 3 ☐ 4 ☐ 5	
22. What was the volume of poultry carcasses imported into Togo in 2007? **22. Combien de carcasses de volailles ont été importées au Togo en 2007?** **Réponse :**	☐ 1 ☐ 2 ☐ 3 ☐ 4 ☐ 5	
23. What proportion of these poultry carcasses might have been re-exported to Ghana? Answer: **23. Quelle proportion de ces carcasses aurait pu être réexportée vers le Ghana ?** **Réponse :**	☐ 1 ☐ 2 ☐ 3 ☐ 4 ☐ 5	
24. What are the travel times (in days) for transporting frozen turkey tails or poultry carcasses from points of origin in Togo to border towns in Ghana?		

24. Quelle est la durée de transport - moyenne, minimum et maximum (en jours ?)- des QDC ou carcasses de volailles, entre leur point de départ au Togo et leur arrivée dans les villes frontalières du Ghana **Réponse : Moyenne _____Minimum _____Maximum _____**	☐ 1 ☐ 2 ☐ 3 ☐ 4 ☐ 5	
25. What types of transport are used in carting frozen turkey tails or poultry carcasses from Togo to Ghana? Answer: **25. Quels moyens de transport sont utilisés pour transporter les QDC et les carcasses de volailles depuis le Togo jusqu'au Ghana ?** **Réponse :**	☐ 1 ☐ 2 ☐ 3 ☐ 4 ☐ 5	
26. What are the numbers of vehicles entering Ghana from Togo through the major entry points in one month? **26. Quel est le nombre moyen, minimum et maximum de véhicules, par mois, qui entre au Ghana depuis le Togo par les points d'entrée principaux?** **Réponse : Moyenne _____Minimum _____Maximum _____**	☐ 1 ☐ 2 ☐ 3 ☐ 4 ☐ 5	
27. What are the most common starting points and routes of vehicles arriving at border towns between Togo and Ghana? Answer: **27. Le plus souvent, d'où viennent et quel trajet font les véhicules qui arrivent à la frontière Togo/Ghana ?** **Réponse :**	☐ 1 ☐ 2 ☐ 3 ☐ 4 ☐ 5	
28. What was the major disinfection procedure for vehicles at Ghana's borders when there was an outbreak of AI in Togo in 2007? Answer: **28. Au Togo, en 2007, quelle avait été la procédure principale de désinfection des véhicules arrivant à la frontière avec le Ghana, lorsque des cas de grippe aviaire étaient déclarés?** **Réponse :**	☐ 1 ☐ 2 ☐ 3 ☐ 4 ☐ 5	
29. How effective were the disinfection procedures adopted? Answer: **29. Ces mesures de désinfection ont-elles été efficaces ?** **Réponse :**	☐ 1 ☐ 2 ☐ 3 ☐ 4 ☐ 5	

Annex 5: List of Approved and known unapproved entry routes into Ghana (Source Ghana Immigration Services, personal communication March 2009).

1. Aflao Sector (border with Togo)	**2. Akanu Sector (border with Togo)**	**3. Nyive Sector (border with Togo)**	**4. Menusu Sector (border with Togo)**	**5.Yendi Sector (border with Togo)**	**6.Bawku Sector (border with BF and Togo)**
Approved Routes	*Approved Routes*	*Approved Routes*	*Approved Routes*	*Approved Routes*	*Approved Routes*
Aflao Command Post	Akanu Command Post	Nyive Command post	Menusu	Yendi Command Post	Missiga
Sogakope	Havi-Ave	Shia	Leklebi Dafor	Tatali	Pulimakom
Known Unapproved Routes	Batume Junction	Honuta	Wli Afegame	Wonjuga	Mognori
Beat 1, 2, 3 ,4, 5	Agotime Afegame	*Known Unapproved Routes*	Baglo	Yawgu	Zebilla
Beat 6, 7, 8, 9, 10	Kpoglo	Liudo	Tinjasi	*Known Unapproved Routes*	Bunkpurugu
Beat 11, 12, 13		Atikpui	Nkwanta	Saboba	Kulungugu
		Kpotoe	*Known Unapproved Routes*	Shieni	*Known Unapproved Routes*
7. Paga Sector (border with BF)		Ashante	Ahamasu	Kugani	Pusiga
Approved Routes			Poasi	Kpankamba	Bimbago
Paga Command Post			CementNsuta	Sangba	Bende
Namoo			Kute		Kpilldkira
Known Unapproved Routes			Kpaso		
Fio			Obebi		
Sirigu			Likpe		
Kayoro			Ampeyou		
			Brewaniase		
Yendi Sector (border with Togo)	**Saboba Sector (border with Togo)**	**Hamile Sector (border with CI and BF)**	**Wa Sector (border with BF and CI)**	**Bole Sector (border with CI)**	**Hohoe Sector (border with Togo)**
Tatale	Yawgu	Nandom	Dorimon	Chache	Wli Afegame
Bimbilla	Chereponi	Tumu	Basie	Mandari	Baglo

Zabzugu	Wonjuga	Lawra	Paga	Ntereso	Ahamansu
Nachamba	Chanchango	Babile	Iziri	Manful	Ayoma
Nakpali	Kpurugu	Fielimon		Gbemfo	Lelebi kame
Kpanda					Ampeyoo
					Likpe
Menusu Sector (border with Togo)	**Nkwanta Sector (border with CI)**	**Gonokrom Sector (border CI)**	**Osei Kojokrom Sector (border with CI)**	**Dadieso Sector (border with CI)**	Agortime Afegame
Nsuta	Tinjasi	Nkrankwanta	Wawase	Antokrom	Leklebi Dafur
Kute	Shiare	Kofi Badukrom	Yamousoukro	Adomikrom/Nsiakrom	
Bodada	Chilinga	Yaakrom	Pillar 36	Lugu	**Yaakese Sector (border with BF)**
Brewaniase	Koue	Agyemangkrom	Main line	Kyensikorkor	Boinso
Poasi Cement	Pawa	Frimpongkrom	Manzano	Africa/Juapong	Dubi
Jasikan			Abudu	Oscar	Sewum
Kedjebi			Kaase	Suibo	Omampe
			Plywood		
Elubo Sector (border with CI)	**Half Assin Sector (border CI)**		Akatiso		
Sameye	Jewi Wharf		Essam barrier		
	Ellanda Wharf		B rebre		
	New Town		Krokouse		

Annex 6: Communiqué from Chief Veterinary Officers in West Africa Meeting in Togo.

RECOMMENDATIONS OF CROSS-BORDER WORKSHOP AT AGBODRAFO, TOGO FROM 11-14 NOVEMBER 2007

The cross-border meeting and the Chief Veterinary Officers (Directors of Veterinary Services) of Bénin, Burkina Faso, Ghana, Ivory Coast, Nigeria and Togo recognize:

1. The importance of the transparency and speed of transmission of zoo-sanitary information;

2. The importance of integrating cross-border measures in respective national contingency plans;

3. The importance of harmonizing sanitary certificates and other documents related to the import/export of animal and poultry products;

4. The high turn-over rate of personnel at border control posts;

5. The importance of harmonizing compensation grids between neighbouring countries, in order to avoid movement of poultry from one country to the other in the event of a disease outbreak;

6. The importance of adequate infrastructure, equipment and means of intervention for the veterinary border posts;

7. The lack of qualified staff at border posts;

8. The importance of the exchange of information, experience and skills between the various stakeholders (law enforcement bodies and others such as customs services);

9. The importance of training border agents in the control of trans-boundary animal diseases;

10. The importance of communication activities related to risk practices in the prevention of the spread of HPAI;

11. The importance of including all stakeholders in the prevention and control of HPAI;

12. The lack of data on the poultry sector;

13. The importance of the rapid, fair and equitable compensation of poultry producers following HPAI outbreaks;

Recommend that:

1. In addition to using the telephone, e-mail and fax, a weekly report, following the model developed during the meeting, will be sent every Wednesday by the CVO of each country to other CVOs and the RAHC

2. Each country will inform their neighbors of the sanitary measures that they intend to put into place in the case of an outbreak near the frontier. The countries will develop a mechanism to establish joint teams with their neighbors for a more effective intervention at the frontier
3. The RAHC will propose a model sanitary certificate to the countries (secured) based on existing national certificates
4. Each country will share with their neighbors a list of authorized officials for the signature of different importation/exportation documents and those of the border posts. A Manual for the use of border agents should be developed and disseminated.
5. The level of indemnity/compensation will be established based on the average market price on each side of the border and the compensation/indemnity should be paid as soon as possible.
6. The Ministries of livestock in charge of equipping the veterinary/sanitary post and providing the necessary means for assuring their missions are carried out correctly at the border.
7. Appointment of qualified and adequately trained agents and in sufficient number at the border sanitary/veterinary posts.
8. Involve the different border agents (security forces, customs, stakeholders involved with the poultry sector along the frontier, etc.) present at the frontier in the training sessions on HPAI and control measures. Authorize agents with experience in the control of HPAI outbreaks to assist the neighbouring country during training sessions.
9. To strengthen the capacity of border post agents on methodologies for the identification of animals ; the importance of zoo-sanitary measures; the risks posed by HPAI and trans-boundary animal diseases; and to make available to them information manuals and standard operating procedures (SOPs);
10. To strengthen communication messages on risky practices -- specifically focusing on cross-border activities – and to disseminate these primarily in the local languages used on both sides of a specific border;
11. To the national authorities to strengthen the capacities of the stakeholders in the poultry value-chain, in particular those located in border areas, and to encourage linkages between poultry associations on both sides of the border;
12. To the veterinary services and department of statistics to establish a data-base for the poultry sector (numbers, farms, producers, traders, processors, geographic location etc)

13. The inclusion, in the animal health regulations, of a provision for compensation payments following HPAI outbreaks – where such provision does not already exist – and to include an allocation for compensation funds in the national budget, as well as to draw on contributions from the private sector and development partners, in order to ensure their sustainability;

Conclusion

The cross border meeting decides to translate these recommendations into a working plan and into a project document within the next 3 months. This document will be submitted for approval by the participants at the next cross border meeting.