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Review Article

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Review on Qualitative Risk Assessment on the Introduction of Highly Pathogenic Avian Influenza (H5N1) Virus in to Ethiopia via Importation of Sasso Breed (Poultry) from France.

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Abstract

Trends suggest that numbers and size of producer flocks are rising and particularly in urban and peri-urban areas.This qualitative risk analysis considers the Avian Influenza Virus (HPAI) risk associated with the importation the Sasso breeds distributed to the farmers of Ethiopia by the ethio-chicken private Company, the cross (F1) of SA51A (female) and T44 (male) from France.

The company imports the parent stock of SASSO Breed which is a commercial breed originating from France and put the breed for hatchery (multiplication), adaptability and likability in selected breeding areas of Ethiopia, Gubure (SNNPR) and Mekele (Tigray) and then distributes the DOC(day old chicken) to different regions of Ethiopia for its customers.

Probability of H5N1 HPAIV being released into Ethiopia is Very low with medium uncertainty and the risk estimate probability of H5N1 HPAIV release into Ethiopia is very high.

This organism was classified as high risk in the commodity and options for the effective management of these risks have been presented. Risk management options discussed in this document include:

➢ Biosecurity constitutes an essential element of the AHI response. Biosecurity measures within the context of poultry production in Africa under traditional management systems must be strengthened and integrated into poultry production and processing of poultry products. For this purpose, knowledge of biosecurity principles for veterinarians, extension agents and major stakeholders in the field will be improved through training and the organization of awareness campaigns

➢ chickens/parent stock could come from an AI-free country, zone, or compartment and be derived from farms which had been kept in an establishment free of all AI viruses for at least 21 days prior to and at the time of the taking of the chickens/parent stock.

➢ Technical capacity of epidemiologists and those responsible for data management will be reinforced by GIS and the use of GPS in order to improve animal disease surveillance and monitoring and the mapping of farming systems in each country.

Keywords: Sasso breeds, Avian, Influenza, Pathogenic ,GIS,GPS

Introduction

The 1997 emergence and rapid spread of the highly pathogenic avian influenza strain H5N1, hereafter HP-H5N1, raised concerns regarding the potential for a global influenza pandemic [1, 2, 3]. The highly pathogenic avian influenza (HPAI) H5N1 has been described as a highly contagious viral disease in several avian species. The disease is characterized by high morbidity and mortality and could be potentially contracted by humans and other warm-blooded animals thus making it an emerging pandemic of zoonotic importance [4, 5].

Since the panzootic of highly pathogenic avian influenza (HPAI) caused by viruses of the H5N1 sub-type occurred in Asia in 2003 and early 2004, the disease has spread to Europe and North and West Africa. It has caused high mortalities in affected poultry flocks, with additional losses due to culling. Farmers and traders have suffered loss of income as a result of market disruption caused by control activities and also market shocks due to consumer concerns for human health. A further concern is that the widespread circulation of the avian influenza virus increases the chances of mutation into a form that could pass from human to human, which could result in a new human flue pandemic of unknown magnitude [6].

The number of countries having been affected by the disease in Africa by March 2009 has reached eleven. These countries include Benin, Burkina Faso, Cameroon, Djibouti, Egypt, Ghana, Ivory Coast, Niger, Nigeria, Sudan and Togo [7]. So far, there has not been an outbreak of the disease in Ethiopia, either in wild or domestic bird populations. Ethiopia, along with other east African Rift Valley nations, such as Kenya, Tanzania and Uganda are, however, considered at risk of being infected because millions of migratory birds flock into these countries during the European winter season [8]. Moreover two of Ethiopia's neighboring countries (Sudan and Djibouti) reported outbreaks of HPAI H5N1 in April and May 2006 respectively [9].

Exporting country is provided with clear reasons for the imposition of import conditions or refusal to import [10].

The purpose is qualitative risk assessment of the introduction of Highly Pathogenic Avian Influenza (H5N1) Virus into Ethiopia Via importation of poultry breed (sasso) from France [11] (Goutard, et al., 2007) and to provide recommendations for import requirements for the generic Import Health Standard (IHS) for the required breed.

Commodity Definition

The commodity is, the Sasso breeds being distributed to the farmers by the Ethio-chicken private Company, the cross (F1) of SA51A (female) and T44 (male) from France. The breed will be healthy (free of disease) during transportation and will be disinfected in accordance with OIE Terrestrial Animal Health Code [10].

Approach

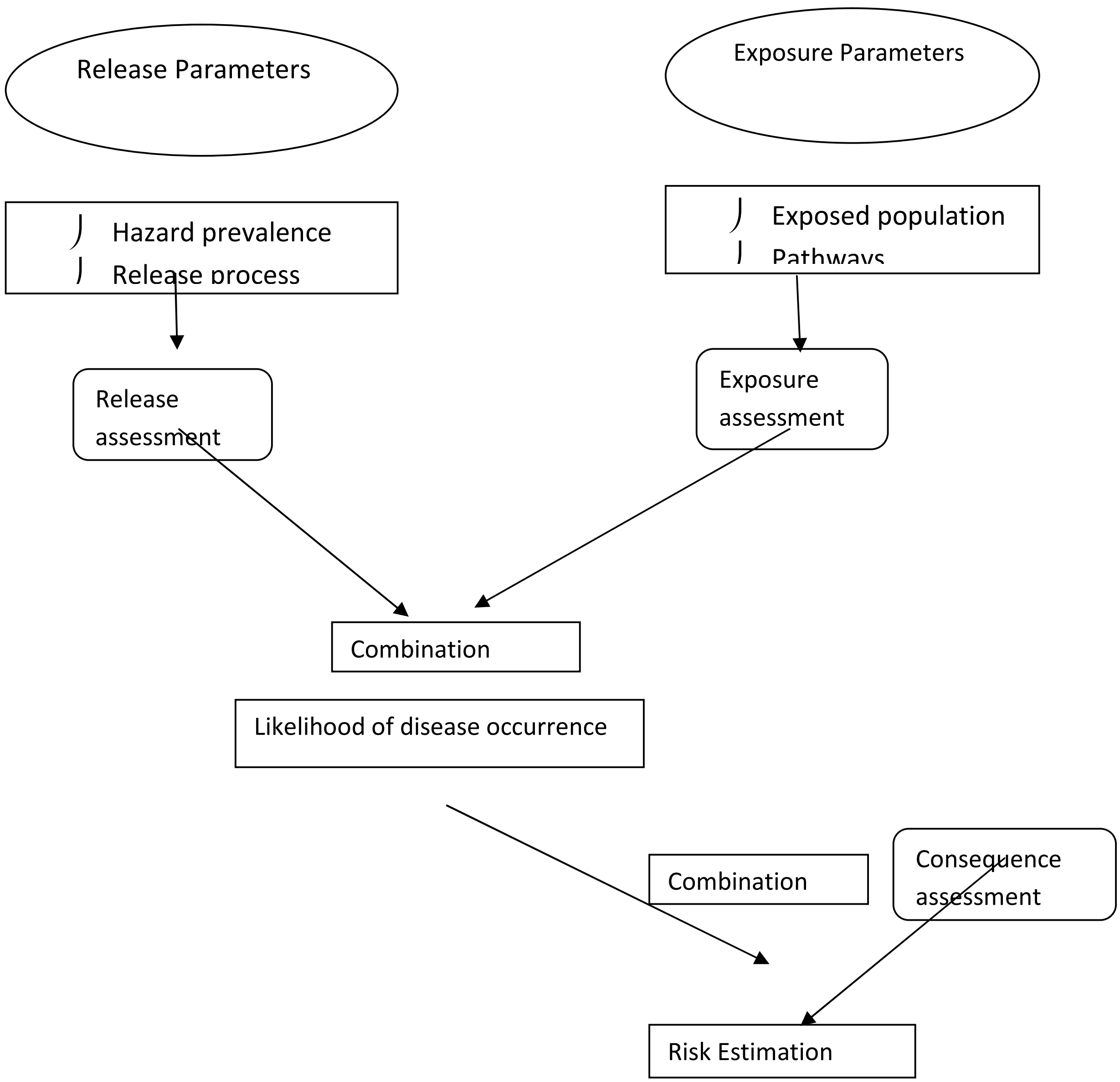
The OIE Terrestrial Animal Health Code principal aim of import risk analysis is to provide importing countries with an objective and defensible method of assessing the disease risks associated with the importation of animals, animal products, animal genetic material, feedstuffs, biological products and pathological material. The analysis should be transparent. This is necessary so that the exporting country is provided with clear reasons for the imposition of import conditions or refusal to import [10].

The framework that has been recommended by the World Organization for Animal Health [12] for risk analysis is used in this approach. The framework outlines four key steps that should be covered systematically. These are:

- Release assessment (probability of release from the source)
- Exposure assessment (probability of exposure to the hazard)
- Consequence assessment (biological consequences such as incidence and severity, economic consequences, etc.)
- Risk estimation (which consists of combining the release, exposure and consequence probabilities).

The events that were considered as contributing to the release, exposure and the consequence pathways were specified and broken down into several stages, with each stage being assigned a conditional probability.

Figure:- 1 events pathway



Risk Communication

There are two potential sources/threats of getting HPAI into the country Ethiopia i.e. from introduction and dissemination of the HPAI H5N1 virus by Migratory Wild Birds and introduction and dissemination of the HPAI H5N1 via the Legal Import of DOC. Issue whether all relevant organizations involved in the poultry sector are working together with clear share of responsibility and accountability, needs to be addressed to tackle this problem.

The Risk Analysis work will be communicated to different concerning stakeholders throughout each step to ensure transparency.

The responsible stake holders should be all concerning gov.t and private/NGOs.To list some project managers relating to poultry production, small scale and large scale poultry production industry owners, small scale chicken rearing farmers, Ministry of Agriculture, Ministry of Trade, Research Institutes, Ministry of Health, Academia, Media and other concerning bodies. Following this process of qualitative risk analysis and review, the Imports Standards team of the country will decide on the appropriate combination of sanitary measures to ensure the effective management of identified risk.

Introduction of Hazard List

A H5N8 clade 2.3.4.4 strain of highly pathogenic avian influenza (HPAI) virus (HPAIV) was first detected in France in November 2016. Until the 3rd of March 2017, 348 cases of HPAI H5N8 and 136 cases of HPAI H5Nx strain closely related to HPAIV H5N8 were detected in poultry, with 80% of cases occurring in waterfowl farms (mainly duck farms) [13].

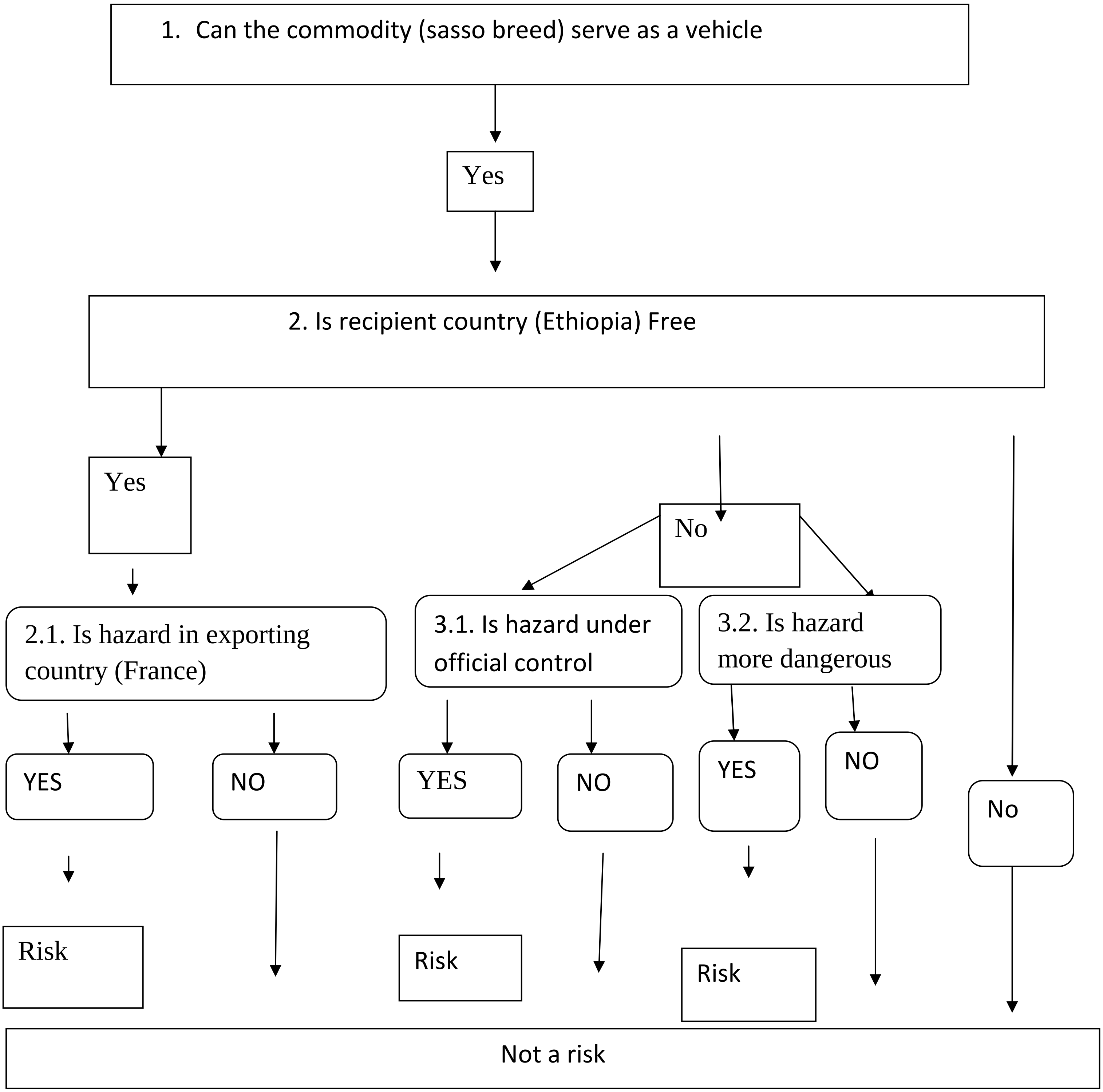
The hazard identification process begins with the spread of a list of organisms possibly associated with the commodity. The table shows biological organisms, chemical agents and physical factors potentially associated with the commodity (sasso breed). This list was compiled from searches associated with avian influenza.

Table 1: Biological Organisms, Chemical agents, and Physical factors potentially associated with the commodity.

Biological	Risk	Chemical	Risk	Physical	Risk
Avian influenza	Yes	Halogens (chlorine, iodine)	Yes	Diseased/infected bird	Yes
Avian leukosis	Yes	All necessary vaccines	Yes		
Avian reovirus	Yes				
West nile virus	Yes				
Avian paramyxovirus 1	Yes	Aldehydes	Yes	Fomites	Yes
Infectious bronchitis spp.	Yes	Quaternary ammoniums compounds	Yes	Plane of transportation	Yes
Infectious laryngotracheitis virus (ILTV)	Yes	Phenol and derived	Yes	Feeding and drinking troops	Yes
Salmonella Gallinarum-Pullorum	Yes	Peroxides	Yes	Needles of vaccination	Yes
Mycoplasma gallisepticum	Yes	Feed and its ingridients	Yes	Personnel handling it	Yes
Mycoplasma synoviae	Yes	Formaline	Yes	BIP(boarder inspection places)	Yes
Avian toxoplasmosis	Yes			Others which has contact with poultry	Yes
Avian metapneumo virus	Yes				

[14]Hafez Mohamed Hafez, 2007), https://www.id-vet.com/wp.../Poultry-product-list-ELISA-PCR-2019-v1doc9254.pdf

Figure 2: scenario Tree showing the pre-assessment of the risk



Hazard Identification

Poultry Trade

Ethiopian trade in poultry and poultry products is limited to the import of live birds. This has important implication for HPAI introduction. The private and public large scale intensive poultry farms are mainly dependent on the import of day old chicks from abroad. In 2005, a total of 736,000 day old chicks had been imported from the Netherlands, Saudi Arabia, Egypt, UK, Germany, and Kenya [8]. Since 2006 Ethiopia has banned import of poultry products from Egypt, UK, and Germany due to the incidence of HPAI in these countries. In 2006/07, some 1,164 day old ducklings were also imported from France [16].

Ethiopia follows the OIE recommendation for the importation of live birds, i.e. exporting country should be free of HPAI and should present serological test proving freedom for Newcastle, Marek, Gumboro, and fowl cholera for a period of 90 days before exportation.

Etiological agent

Avian influenza is caused by influenza A viruses which are common in wild birds and occasionallyinfect poultry occurring within the family Orthomyxoviridae. When poultry are infected, they may have no disease, mild diseaseor very severe disease. Chickens, quail and turkeys are especially susceptible while ducksmore commonly show no disease, but act as a reservoir for the virus. Other poultry species,including guinea fowl and pheasants, and also ostriches, can become affected.

Influenza viruses have two main surface antigens, haemagglutinin (H) and neuraminidase(N). There are many H and N subtypes, but historically highly pathogenic avianinfluenza viruses have been either H5 or H7, and to a lesser degree H9. AI viruses are also classified by pathotype – highly pathogenic (HPAI) and low pathogenic (LPAI) – a biological characteristic of the virus' virulence in chickens. Currently, thepathotype definition has been expanded to include the genetic sequence coding for basicamino acids in the cleavage site of the H protein. All AI viruses that have these sequencesat the critical site are considered notifiable and the viruses are denoted as HPNAI (highlypathogenic notifiable avian influenza) and LPNAI [17].

OIE list

Notifiable avian influenza (NAI) viruses are on the OIE List. NAI refers to any avian influenza virus of H5 or H7 subtypes or any AI virus with pathogenicity above limits set in chapter 2.7.12 of the OIE Terrestrial Animal Health Code [10].

Ethiopian Status

So far, there has not been an outbreak of the disease in Ethiopia, either in wild or domestic bird populations. Ethiopia, along with other east African Rift Valley nations, such as Kenya, Tanzania and Uganda are, however, considered at risk of being infected because millions of migratory birds flock into these countries during the European winter season [8]. Moreover two of Ethiopia's neighboring countries (Sudan and Djibouti) reported outbreaks of HPAI H5N1 in April and May 2006 respectively [9] (OIE, 2009). HPAI has never been reported in Ethiopia, where general and targeted surveillance measures are in place. Notifiable LPAI was last reported in Ethiopia in 2006 [15].

Epidemiology

Live poultry markets are an important part of the poultry supply chain in many parts of the world, but they have been implicated in the zoonotic transmission of avian influenza viruses from live poultry to traders and customers [18]. The recent outbreak of avian influenza was the largest in the history of the South African poultry industry, with greater losses of poultry and eggs, trade restrictions and market losses. The epidemiology of avian influenza viruses is not well understood, because there are many vectors, including wild birds and other wildlife [19].

This transmission can occur via direct or indirect contact, although in many cases the exact route is not known [18]. In as much as water birds are perceived to be the natural host of avian influenza [20] large concentrations of both backyard and intensive system flocks, coupled with poor disease control or underfunded veterinary services, pose significant risks for the spread of the disease [19].

Biosecurity Implications

The findings from the risk assessment undertaken by [8] for the introduction of HPAI H5N1 virus in Ethiopia found:-

- The quantitative risk of introduction of the virus via DOC legal trade was assessed as ‘low, but likely to occur’.-
- The qualitative risk of introduction of the virus via wild migratory water birds was assessed as ‘low’.
- Subsequent recommendations were made for the improvement of an early warning surveillance system to track incoming infestation and, importantly, the need to follow similar developments in those countries of origin from which parent stock of sasso and similar were imported into the country.

Hazard Identification Conclusions

NAI viruses must be considered to have the potential to lead to the development of disease and are classified as potential hazards in the commodity. There are also a number of non-NAI subtypes with the capacity to cause disease in poultry.

The full potential for such disease relationships is not understood and genetic changes in non-NAI strains, or encounters with new potential hosts, may result in disease.

Therefore all avian influenza viruses are classified as potential risk in the commodity.

Risk Assessment

Entry Assessment

This takes into account the infection status of source (exporting) countries, susceptibility of the species involved, incubation period of the disease in the species, and the presence of veterinary checks, appropriate holding facilities and disposal practice in the Border Inspection Points (BIP) of Ethiopia and their abilities to detect and contain the hazard upon release. AI virus can be isolated from breeder flocks with clinical disease and from an infected flock with no clinical signs [21].

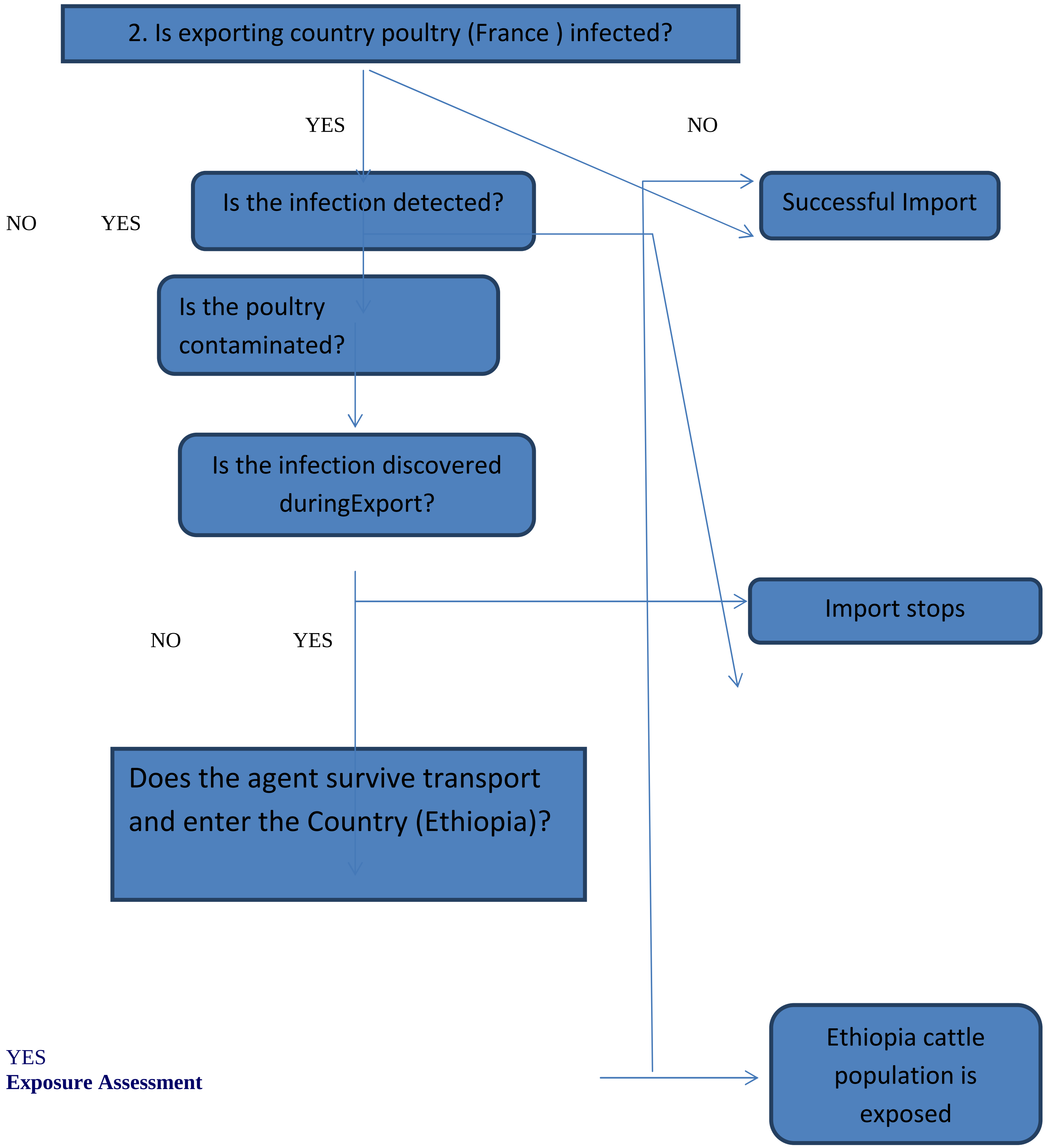
Information available

Upon arrival in Ethiopia, the transiting wild birds (confined in their cages) are taken to a shaded open space specifically meant for birds waiting for a flight connection. They are kept here for an average of 12-24 hours under the care of transit attendants. The transit attendants check for international veterinary certificate and have a quick look on the birds to see if there is any sick looking or dead animals (Information obtained from the Transit supervisor and Animal and Animal Products Quarantine and Inspection Unit at Bole International Airport).

The transit attendants transfer any sick or dead birds identified on arrival to the waiting ground, along with others, and prepare a report. These birds are kept in their cages in the waiting ground (with the sick ones receiving some nursing care) until they are shipped to their destination.

The incubation period of the disease ranges from 3 days in naturally-infected individual birds to 14 days for a flock [22] (Swayne and Halvorson 2003). The Code gives the incubation period for the purpose of international trade as being 21 days [23]. Therefore, this risk assessment considers that susceptible birds may be viraemic up to 21 days following exposure. They may therefore, act as reservoirs of the virus with a potential of exposing other susceptible birds to the infection before showing clinical signs of the disease.Probability of H5N1 HPAIV being released into Ethiopia is Very low with medium uncertainty and the risk estimate probability of H5N1 HPAIV release into Ethiopia is very rare but cannot be excluded.

Figure3.Scenario tree used for the entry assessment



Virus survival is highest in moist faeces, significantly high in water especially if it is cold and little survival occurs in dry and sunny conditions. The period of infectivity will increase with decreasing temperature, from 4 days in 25-32oC to more than 3 weeks at 4oC.

The role of aerosol in the transmission of Asian lineage H5N1 HPAIV is unclear, but it may be less important than faecal-oral transmission. This contrasts with human influenza viruses which are considered to be mainly transmitted via aerosol [24].

Table.2. Stability of H5N1 HPAI virus in faeces and water

Material	Parameter	Time	Result	Reference
Chicken faeces (H5N1 HPAIV)	25-320c	4 days	No infectivity retained	[25]
Surface water (H5N1 HPAIV)	Not specified	3 days	No infectivity retained	

Table -3

	Exposure risk category						
Release risk category		Negligible	Very Low	Low	Medium	High	Very High
	Very High	N	VL	L	M	H	VH
	High	N	VL	L	M	H	VH
	Medium	N	VL	L	M	H	VH
	Low	N	VL	VL	L	M	H
	Very Low	N	N	VL	VL	L	M
	Negligible	N	N	N	N	N	N

AI virus is spread via respiratory aerosols, faeces, fomites, and people, with the fecal-oral route being the most important [21].

The exposure assessment for AI viruses is considered to be high uncertaintyand the probability is estimated to be medium [26]

Consequence Assessment

Avian influenza impact assessments could identify environmental consequences of outbreaks, including possible environmental contamination/spread of the disease agent, loss of biodiversity of species through mortality/culling and impact from incineration and burial of carcasses.

There is a high likelihood that the importation of HPAI viruses could result in epidemic disease in Ethiopia poultry with high mortalities and disruption of the poultry industries and export trade in poultry products. AI viruses in this commodity are considered to be a hazard to the Ethiopian poultry industry and to the economy [27, 28].

The likelihood of adaptation or genetic re-assortment of AI viruses leading to the development of new strains capable of causing serious disease in humans is considered to be very low. The epidemiology of the development of strains of AI virus pathogenic to humans is such that AI viruses in this commodity are considered to be a potential hazard to human health [29, 30].

The consequence assessment for AI is considered to be highand the probability is estimated to be very high.

Risk category combination matrix tables

For combination of the combined release and exposure risk estimate with the consequence risk can be estimated as below by using tables:

Table-4

Combined release and exposure risk category	Consequence risk category		
		High	Very high
	Very hign	H	VH
	High	H	VH

Risk Estimation

Because entry, exposure, and consequence assessments are non-negligible, using ordinal scale of risk table, the overall risk estimates is high. Therefore, risk management measures can be justified.

Risk Management

One or a combination of the following options could be considered in order to effectively manage the risk:-

➢ Biosecurity constitutes an essential element of the AHI response. Biosecurity measures within the context of poultry production in Africa under traditional management systems must be strengthened and integrated into poultry production and processing of poultry products. For this purpose, knowledge of biosecurity principles for veterinarians, extension agents and major stakeholders in the field will be improved through training and the organization of awareness campaigns

➢ Chickens/parent stock could come from breeding establishments and hatcheries compliant with the standards documented in the OIE Terrestrial Animal Health Code [10] (OIE, 2016) (or equivalent) and be transported in new transporting material.

➢ chickens/parent stock could come from an AI-free country, zone, or compartment and be derived from farms which had been kept in an establishment free of all AI viruses for at least 21 days prior to and at the time of the taking of the chickens/parent stock.

➢ As indicated the OIE Terrestrial Animal Health Code [10] (OIE, 2016), birds could be randomly tested using virus detection or isolation tests, and serological methods, and the frequency of testing should be based on the risk of infection and at a maximum interval of 21 days. Test methods used could detect all group of influenza A viruses. The number of birds sampled would depend on the expected minimum prevalence of infection and the level of confidence required for its detection. In flocks from which 30 sera were tested using an ELISA targeting subtype H9N2, between 1 (3 percent) and 30 (100 percent) sera were positive from individual flocks. 95 percent confidence that the seroprevalence in the flock is below 5 percent is a reasonable basis for determining sample numbers.

➢ The introduced parent stock should be kept under secure quarantine areas in Ethiopia and a sample of stock tested prior to distribution.

➢ Technical capacity of epidemiologists and those responsible for data management will be reinforced by GIS and the use of GPS in order to improve animal disease surveillance and monitoring and the mapping of farming systems in each country.

Conclusion and Recommendations

Once the HPAI reaches to the status of human-to-human transmission, it can affect up to a quarter of the world population and can rapidly spread around the world in less than three months. This threat can be averted mainly by early detection of infection among poultry and then taking adequate measures to prevent the spread (such as through culling) from the infected batches.

The potential danger of risk of AI in Ethiopia is associated with the following three main reasons: -

➢ Many millions of birds that possibly carry the virus migrate from affected areas of Europe and Asia to East Africa and believed to reach lakes and wetland found in the rift valley of Ethiopia.

➢ The limited biosecurity measures in the poultry production system, where almost every household in rural areas practice backyard poultry and commonly live with their poultry in the same house or in an attachment where there is no barrier the potential for becoming in contact with infected poultry droppings and corpses, which are major sources of infection, is very high.

➢ The existing uncontrolled animal movements exercised under the prevailing management system

So far Ethiopia has not had a confirmed case of the H5N1 strain in birds or domestic fowl. There was suspicion of a threat of AI in Ethiopia in Gurage state poultry multiplication center in 2006. The base for the suspicion was the death of hundreds of chickens at a state breeding and multiplication centre in Gurage, where all chickens at the centre were eventually culled. A false positive result emerged from the initial screening in Ethiopia, which subsequent analysis at a lab in Italy showed up negative result for the presence of the H5N1 virus. However, this situation led to massive consumer panic about chickens, depressed demand, and price falls.

The government in response ran public information bulletins advising people of the risks of touching diseased fowl. Later, these bulletins were replaced with information explaining public safety measures when handling healthy and potentially sick chickens. The impact of these public service announcements was to instill a sense of panic, particularly in Addis. As a result, demand for chickens plummeted. Though a false alarm it highlighted the potential of a significant impact of HPAI in Ethiopia.

The government of Ethiopia has responded in several ways with both a strategic plan and an emergency preparedness plan. The government also ran large scale information campaigns. How far the arrangements can meet the needs of control strategies in a pro-poor fashion will depend on whether or not there is an outbreak, its source and most importantly its extent.

➢ Strengthen the capacity of the Urban Agricultural Departments to enable them to better monitor and/or supervise the health of the birds making up the local poultry industry.

➢ In training small-scale farmers, a serious linkage between poultry development and the poultry health plan should be created to improve public health hazards. Throughout the country, recent outbreaks of avian influenza continue to be a source of considerable concern.

➢ If the outbreak occur, immediate reporting should be prioritized according to the OIE Terrestrial Animal Health Code (2007), countries that identify HPAI should report the occurrence to OIE within 24 hours.

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