



FAO RAPID QUALITATIVE RISK ASSESSMENT

Risk of H5 high pathogenicity avian influenza introduction in Central and South America and the Caribbean

SUMMARY

- The **risk of introduction** of the H5 highly pathogenic avian influenza (HPAI) virus into known unaffected countries in Central and South America and the Caribbean during the period January to March 2023 through the **trade of live birds and poultry products/by-products** can be generally considered as **negligible**. The risk of introduction through the **informal trade of fighting cocks** was assessed as **low**, while introduction through **wild bird movements** was assessed as **moderate to high**.
- The likelihood of **domestic birds** being **exposed** to the H5 HPAI virus through the **trade of poultry products/by-products** was assessed as **very low**. Exposure through the **live bird trade** was assessed as **low** except for the **informal trade of fighting cocks**, which was assessed as **moderate**. Exposure through **migratory birds** was assessed as **moderate to high**.
- The consequences of HPAI introduction (direct and indirect losses related to infected birds) into countries and territories in the region during the next three months are likely to be felt in the poultry production sector – specifically the backyard poultry sector, which is an important contributor to food security in the region. Virus spillover into local and endemic wild bird species is also likely.

BACKGROUND

Epidemiological situation in the region

The world is experiencing an unprecedented H5 HPAI panzootic that began in 2020, with more than 70 countries across Africa, the Americas and Eurasia affected by the disease. At the end of 2021, a shift in avian influenza (AI) virus subtype circulation was observed, with H5N1 clade 2.3.4.4b rapidly becoming the major virus subtype responsible for most HPAI events reported worldwide (Figure 1).

This panzootic was first detected in the Americas¹ in Canada in December 2021, in poultry in the eastern province of Newfoundland and Labrador. It was first detected in the United States of America on 13 January 2022, in an American wigeon (*Mareca americana*) in South Carolina (Bevins *et al.*, 2022).

¹ According to the United Nations classification, the Americas includes North, Central and South America and the Caribbean (United Nations Statistics Division [UNSD], 1999).

FIGURE 1: H5 HPAI events (outbreaks and detections) observed in the Americas from 1 October 2021 to 29 January 2023



Source: Food and Agriculture Organization of the United Nations (FAO). 2023. Global Animal Disease Information System. Cited 29 January 2023. <https://empres-i.apps.fao.org>

This was the first report of H5 HPAI to have occurred via the transatlantic route (Caliendo *et al.*, 2022).

The H5 HPAI virus spread towards the northwest during the spring migration period (March–May) in the first half of 2022, infecting multiple domestic birds in Canada and the United States of America. Subsequent southward spread resulted in H5N1 HPAI outbreaks reported from October 2022 to January 2023 in the Bolivarian Republic of Venezuela (1), Chile (12), Colombia (27), Costa Rica (1), Ecuador (1), Honduras (1), Mexico (25), Panama (1) and Peru (6). These outbreaks included both domestic and wild birds.

Susceptible species and transmission of the virus

Past intercontinental spread of AI has demonstrated the role of wild aquatic birds of the Anseriformes and Charadriiformes orders as long-distance carriers for HPAI viruses (Sharshov *et al.*, 2017). HPAI is transmitted through direct or indirect contact. Birds of prey and scavengers may also be infected by preying on infected birds or feeding on contaminated carcasses. Interactions (direct or indirect) between wild and domestic birds provide opportunities for virus spillover into farms. Once introduced into a flock, onward spread of HPAI between farms is likely to varying degrees, depending on biosecurity practices.

The current H5N1 HPAI epizootic has demonstrated unique characteristics. Firstly, it has particularly affected wild birds with thousands of events reported, affecting over 100 species (Canadian Food Inspection Agency, 2022; United States Department of

Agriculture, Animal and Plant Health Inspection Service [USDA APHIS], 2022). Secondly, it is the first time, to our knowledge, that the virus has persisted in North America over the northern hemisphere summer (June–September 2022), showing similar patterns to those observed in Europe during the period July–August 2021. The continuous circulation of HPAI virus in wild birds has important epidemiological implications for the risk of introduction and spread, particularly with respect to long-distance migrations.

Wild mammals have also been affected by H5 HPAI in North America (including several land mammal species), as have Phocidae populations. Recent experimental studies in ferrets suggest greater mammalian host-adaptation of H5 HPAI clade 2.3.4.4b as compared to previous AI virus clades (Pulit-Penalzoa *et al.*, 2022).

The zoonotic potential of the H5 clade 2.3.4.4b viruses responsible for the current panzootic has already been demonstrated by the reported sporadic spillover episodes from poultry to humans in China, the Russian Federation, Spain, the United Kingdom of Great Britain and Northern Ireland, the United States of America and, recently, Ecuador. Human infection with AI viruses generally occurs after unprotected contact with infected birds or surfaces contaminated with the virus (Centers for Disease Control and Prevention, 2022).

RISK ASSESSMENT SCOPE

This qualitative risk assessment was conducted with data available up to 31 January 2023. It aims to shed light on high-risk pathways for H5 HPAI virus introduction and guide mitigation measures in unaffected countries and territories in Central and South America and the Caribbean.

The risk assessment will provide awareness of risk for the period from 1 January to 1 March 2023 and is subject to update as new information arises.

Risk pathways

Based on the epidemiology of HPAI and previous risk assessments conducted by the FAO (2022a), the key risk pathways considered for H5 HPAI introduction into unaffected countries and territories in Central and South America and the Caribbean were:

- importation of live birds² through formal/informal trade;³
- importation of poultry products and by-products through formal/informal trade; and
- migratory bird movements.

² Live birds include domestic poultry species, ornamental birds and any other traded bird species.

³ According to the [United Nations Conference on Trade and Development \(2023\)](#), informal trade is “trade between neighbouring countries conducted by vulnerable, small, unregistered traders”.

Main risk questions

Three questions on the likelihood of entry were formulated and addressed based on the key pathways highlighted for H5 HPAI introduction (questions 1 to 3, below) as well as one additional question on the likelihood of exposure (question 4).

Likelihood of entry

Question 1: *What is the likelihood of the H5 HPAI virus entering unaffected countries/territories in Central and South America and the Caribbean from affected countries in the Americas through the trade of live birds (formal and informal)?*

Question 2: *What is the likelihood of the H5 HPAI virus entering unaffected countries/territories in Central and South America and the Caribbean from affected countries in the Americas through the importation of poultry products/by-products (formal and informal)?*

Question 3: *What is the likelihood of the H5 HPAI virus entering unaffected countries/territories in Central and South America and the Caribbean from affected countries in the Americas through migratory bird movements?*

Likelihood of exposure

Question 4: *If the H5 HPAI virus enters a currently unaffected country or territory in Central and South America and the Caribbean, how likely is it that domestic hosts capable of onward spread will be exposed to the virus via the three pathways considered?*

Methodology

A qualitative risk assessment was conducted to assess the likelihood of H5 HPAI from affected countries in the Americas being introduced into unaffected countries and territories in Central and South America and the Caribbean, where H5 HPAI infection is not reported at the time of writing. The risk assessment will provide awareness of risk for the upcoming period from 1 January to 1 March 2023 and is subject to update as new information arises.

The risk assessment considers information available up to 31 January 2023 and is based on the major risk pathways outlined previously. Five levels of likelihood (Table 1) were used to qualitatively determine the likelihood of introduction, according to a risk matrix that combines the entry and exposure likelihoods adapted from Dufour *et al.* (2011).

In addition, it considered three levels of uncertainty when interpreting the available data based on data quality and quantity. The definitions used for uncertainty levels are described in Table 2.

A questionnaire addressing HPAI risk factors and capacity for HPAI preparedness, diagnosis, prevention and control was distributed in August 2022 to animal health services in 31 recipient countries in Central and South America and the Caribbean (Annex B).

TABLE 1 Levels of likelihood and their respective definitions

Likelihood estimate	Definition
High (H)	The event is highly likely to occur
Moderate (M)	The event is likely to occur
Low (L)	The event is unlikely to occur
Very low (VL)	The event is very unlikely to occur
Negligible (N)	The event is extremely unlikely to occur/almost never occurs

Source: FAO. 2018. Addressing Zaire ebolavirus (EBOV) outbreaks: Qualitative entry and exposure assessment update. Animal Health Risk Analysis – Assessment No. 6. Rome, FAO. www.fao.org/3/CA0908EN/ca0908en.pdf

TABLE 2 Levels of uncertainty and their respective definitions

Level of uncertainty	Definition
High	Lack of data, limited data or lack of conclusive data; weak correlation or crude speculation
Medium	Small sample data set(s), fair correlation/good fit; reliable method
Low	Large sample data set(s); known fact, event known to occur or exact measure

Source: FAO. 2018. Addressing Zaire ebolavirus (EBOV) outbreaks: Qualitative entry and exposure assessment update. Animal Health Risk Analysis – Assessment No. 6. Rome, FAO. www.fao.org/3/CA0908EN/ca0908en.pdf

Out of the 31 recipients, 21 responses to the questionnaire were received and collated in a spreadsheet for analysis. To supplement the questionnaire data, additional information on countries (including those not targeted by the questionnaire) and risk factors for H5 HPAI introduction was retrieved from various secondary sources.

RESULTS

This section considers evidence about hazard identification and drivers described in the background section as well as additional data from questionnaires and literature review. Annex A provides the risk assessment outcomes for each country/territory and key risk pathways addressed.

Likelihood of entry

Question 1: *What is the likelihood of the H5 HPAI virus entering⁴ unaffected countries and territories in Central and South America and the Caribbean from affected countries in the Americas through:*

a. the formal trade of live birds?

Considering:

- Evidence included in the background section.
- Based on the data provided by the countries that responded to the questionnaire:

⁴ Entry into a country/territory through trade means that infected animals or contaminated products pass the inspections at the point of entry and enter the local production or food chain. Detection and response at a point of entry is not considered entry into a country/territory.

- All countries (except Curaçao and Uruguay) require prior approval to release import permits before importation and are currently imposing bans on the importation of poultry and its products from AI-affected countries/zones.
- All but four countries ban the importation of poultry and its products from countries/zones where AI vaccination is practised.
- All but seven countries implement border inspections by knowledgeable officers.
- Only Argentina reported acting as a transit point for poultry exported from other countries in the region (Brazil).
- Thirteen out of 21 countries have a very high level of preparedness for quarantine and movement control.
- All countries (except Curaçao) implement AI surveillance (passive and/or active).
- All countries have at least one public laboratory capable of performing AI diagnosis, including via reverse transcription-polymerase chain reaction (RT-PCR) and serology – except Suriname, which only has serological testing capacity (enzyme-linked immunosorbent assay [ELISA]), and Curaçao, which has no data. All countries (except Mexico and Paraguay) reported personnel and/or logistical challenges at their labs. (Please see other factors listed in Annex B.)
- In the Americas, the largest importers of live poultry⁵ from Canada and the United States of America during 2021 include Mexico, as well as several countries and territories in Central America (Belize, Costa Rica, El Salvador, Guatemala, Honduras, Nicaragua and Panama), South America (Argentina, Colombia, Ecuador and Peru) and the Caribbean (the Bahamas, Dominican Republic, Haiti, Jamaica, and Trinidad and Tobago). The day-old chick market is by far the most significant of all day-old poultry markets. Colombia mainly exports live poultry and poultry products to neighbouring countries such as the Bolivarian Republic of Venezuela and Ecuador (UNSD, 2022). According to commodity trade databases, Mexico does not export live poultry to other countries and territories within the Americas (FAO, 2022b; UNSD, 2022).
- For commercially produced day-old poultry or fertile eggs from Canada or the United States of America, the likelihood of infection with the H5 HPAI virus is considered very low. This is due to several factors, including the export coming from HPAI-free zones (as requested by the importing countries), the survival rate of HPAI-infected hatching eggs and day-old birds, and the integrated and high-level biosecurity environment in which hatching eggs and day-old birds are produced (Goldsmith *et al.*, 2013). However, HPAI infection of day-old birds could occur later, through contact

with contaminated surfaces and fomites during transportation in the exporting and/or transit countries.

- No ornamental birds are exported to the assessed countries from other countries in the Americas; the reported exporters are Belgium, Spain, Germany and South Africa.

The likelihood of the H5 HPAI virus entering unaffected countries and territories from affected countries in the Americas through the **formal** live bird trade is considered:

- very low for Argentina, Belize, Brazil, Cuba, El Salvador, Nicaragua, Paraguay and Uruguay (medium uncertainty);
- low for Guatemala, Honduras, Jamaica, Suriname, Trinidad and Tobago (medium uncertainty);
- moderate for Curaçao (medium uncertainty); and
- low for the other countries in the Caribbean and Central and South America (high uncertainty).

b. the informal trade of live birds?

Considering:

- Evidence presented under question 1a.
- Affected countries in the Americas (Bolivarian Republic of Venezuela, Colombia, Ecuador, Honduras, Mexico, Panama and Peru) where HPAI outbreaks in poultry have been reported share several land borders with unaffected countries.
- Informal trade in live poultry from H5 HPAI-affected countries in the Americas to other neighbouring countries is not a common practice. Wildlife trafficking has been documented between Latin America and the Caribbean and the United States of America – as reflected by seizures involving live animals (e.g. reptiles, or birds such as parrots, parakeets or macaws) at points of entry (Goyenechea and Indenbaum, 2015). However, this informal trade in live animals is mainly directed towards the United States.
- Informal trade is unlikely to happen in certain areas due to the difficult and dangerous terrain, including major national forests to cross and the absence of main roads (e.g. crossing from Colombia to Panama or Brazil).
- Given the acute and severe clinical progression of HPAI in poultry, particularly in chickens and turkeys, it is unlikely that HPAI-infected live birds would survive informal transport from infected countries to other parts of the Americas. Nonetheless, subclinical HPAI infections have been observed in several broiler flocks in Europe with clade 2.3.4.4b H5N1 HPAI viruses (Gobbo *et al.*, 2022). This suggests that silent infections caused by the H5 HPAI virus may be possible and may contribute to the introduction of the virus in unaffected countries or areas.
- Latin America is in the top 5 percent of regions with the largest number of traded species per territory for birds and amphibians. Political and socioeconomic instability,

⁵ Live poultry includes chickens, turkeys, ducks, geese and guinea fowls.



Traditional chicken and duck breeding facility, Guyana.

commonly found in Latin American countries, have been cited as factors that aggravate the establishment of illegal markets ([Morcatty, 2021](#)).

- In Latin America, cockfighting is widely practised ([Forsyth, 1996](#); [Aldana, 2020](#)).
- In the Caribbean, fighting cocks are handled and looked after as pets. They are bred in farms (possibly with other poultry) or in backyards where they have contact with roaming chickens. Trade involves many Caribbean islands and includes illegal entries ([Laurent et al., 2012](#)).
- Illegal attempts to enter fighting cocks have been reported in Mexico, where cock fighting attracts participants who are mainly rural and small-town dwellers, who involve their family and friends in the activity ([Orihuela and Solano, 2015](#)).
- H5 HPAI is characterized by a short incubation period and severe outcomes in chickens, so it is unlikely that HPAI-infected fighting cocks would survive the stress of illegal transportation during cross-border movement, unless some exporting countries illegally vaccinate fighting cocks against H5 HPAI. However, illegal movement may occur from one country to another in a few hours over short distances, where the transportation period is shorter than the incubation period.

- Curaçao, El Salvador, Guatemala, Mexico, Nicaragua, Paraguay and Peru reported some informal/illegal attempts to enter poultry (including fighting cocks) from other countries in the Americas.

The likelihood of entry of the H5 HPAI virus from affected countries to unaffected countries and territories in Central and South America and the Caribbean through the informal trade of live birds is considered:

Birds other than fighting cocks:

- very low for Argentina, Belize, Brazil, Cuba, El Salvador, Guatemala, Nicaragua, Paraguay and Uruguay (medium uncertainty);
- low for Jamaica, Suriname, Trinidad and Tobago (medium uncertainty);
- moderate for Curaçao (medium uncertainty); and
- low in the other Caribbean and Central and South American countries (high uncertainty).

Fighting cocks:

- low for all countries (medium uncertainty).

Question 2: *What is the likelihood of the H5 HPAI virus entering unaffected countries/territories in Central and South America and the Caribbean from affected countries in the Americas through:*

a. the formal importation of poultry products/by-products?

Considering:

- Evidence presented in the background section and under questions 1a and 1b.
- Chicken meat (fresh, chilled and frozen) represents the highest volume of poultry product exported from North America, followed by turkey meat and, to a much lesser extent, duck meat. Brazil is the number one exporter of poultry meat globally, followed by the United States of America, while Argentina is considered one of the top five exporting countries of poultry meat ([van Horne and Bondt, 2013](#)). To a lesser extent, Canada (FAO, 2022b) and Chile ([van Horne and Bondt, 2013](#)) are important exporters of poultry products (fresh, chilled and frozen meat; hen eggs in shells; and eggs in shells from other birds). As compared



A trainer of fighting cocks carrying his rooster, Dominican Republic.

to the United States of America, the volume of exports of poultry products (fresh, chilled, frozen or processed meat, and eggs) from Colombia or Mexico to Central and South America and the Caribbean are considered low. Colombia mostly exports to neighbouring countries, including the Bolivarian Republic of Venezuela and Ecuador. Mexico supplies several countries in the Americas (Bolivarian Republic of Venezuela, Costa Rica, Cuba, El Salvador and Guatemala) and has increasingly gained market shares in terms of export of poultry products.

- Eggs from infected hens may harbour the H5 HPAI virus (Sims and Narrod, 2007; Uchida *et al.*, 2016). However, considering the general malformation of infected eggs and the fact that HPAI-infected hens are either too sick to produce eggs or die quickly, it is unlikely that infected eggs will be found along the poultry value chain.
- Poultry by-products for use in animal feed (e.g. bone meal, blood meal, feather meal) are imported from various countries, including Australia, Brazil, China, Colombia and the European Union. AI viruses can survive for several days in meat (fresh, chilled or frozen), eggs or offal. Poultry products and by-products that are thoroughly cooked or processed (i.e. heated, boiled, cured or smoked) are unlikely to contain any viable HPAI virus, since these processes generally inactivate the virus.

The likelihood of entry of the H5 HPAI virus from affected countries to unaffected countries and territories in the Americas through the formal trade of raw poultry products and by-products is considered:

- very low for Argentina, Belize, Brazil, Costa Rica, Cuba, El Salvador, Nicaragua, Paraguay and Uruguay (medium uncertainty);
- low for Guatemala, Jamaica, Suriname, and Trinidad and Tobago (medium uncertainty);
- moderate for Curaçao (medium uncertainty); and
- low for the other countries and territories in Central and South America and the Caribbean (high uncertainty).

The likelihood of entry of the H5 HPAI virus from affected countries to unaffected countries and territories in Central and South America and the Caribbean through the formal trade of processed poultry products and by-products (treated with processing measures capable of inactivating AI viruses according to World Organisation for Animal Health [WOAH] standards) is considered negligible for all countries (low uncertainty).

b. the informal importation of poultry products/by-products?

Considering:

- Evidence presented in the background section and under questions 1 and 2a.

- Informal trade of poultry products and by-products originating from Canada or the United States of America is not documented, and only a few countries and territories in the Caribbean reported informal imports of poultry products. Poultry products and by-products smuggled outside Canada or the United States of America are expected to be mostly cooked or processed.
- Trinidad and Tobago reported illegal smuggling of 10 000 table eggs from the United States of America; Chile reported illegal entries of eggs from Cochabamba, Bolivia, given the price difference; while Guatemala detected efforts to smuggle eggs and sausage from Mexico and discarded chicken from Honduras.
- Questionnaire respondents reported low volumes of informal trade of poultry products among countries in Central America, involving consumption eggs, processed poultry meat or chicken sausages.
- In all countries responding to the questionnaire, any live poultry or poultry products entering informally and seized by the customs or border control authorities are either destroyed or returned to the country or territory of origin.

The likelihood of entry of the H5 HPAI virus from affected countries into unaffected countries in Central and South America and the Caribbean through informal trade of poultry products and by-products is considered:

- very low for Argentina, Belize, Brazil, Costa Rica, Cuba, El Salvador, Guatemala, Nicaragua, Paraguay and Uruguay (medium uncertainty);
- low for Honduras, Jamaica, Suriname, and Trinidad and Tobago (medium uncertainty);
- moderate for Curaçao (medium uncertainty); and
- low for the other countries and territories in Central and South America and the Caribbean (high uncertainty).

Question 3: *What is the likelihood of the H5 HPAI virus entering unaffected countries/territories in Central and South America and the Caribbean from affected countries in the Americas through migratory bird movements?*

Considering:

- Evidence presented in the background section.
- Different wild migratory bird species fly from the northern part of the Americas to the south using the three main known migratory routes: Pacific, Mississippi and Atlantic (Afanador-Villamizar *et al.*, 2017).
- Wild migratory birds are the major driver of HPAI introduction and spread over long distances, and virus incursions in Africa, Eurasia and the Americas have shown how quickly the virus may be carried across boundaries. Wild waterfowls and particularly dabbling ducks are

natural reservoirs of LPAI viruses and have been shown to be important actors in the persistence of AI viruses (Prosser *et al.*, 2022). However, given their higher tolerance for infection, these bird species also play a key role in the long-distance spread of HPAI, transmission to other bird species, or spillover to domestic birds. As per Kent *et al.* (2022), most dabbling duck species showed an increase in influenza A virus prevalence in late summer and autumn in the northern hemisphere, which coincides with southward migrations.

- As of 15 November 2022, and since the reintroduction of the virus in North America in 2021, there have been at least:
 - 4 000 confirmed H5 HPAI detections in wild birds, involving about a hundred different wild bird species across 46 states in the United States of America (USDA APHIS, 2022);
 - 1 000 confirmed HPAI detections in wild birds, involving at least 70 different species across all 13 provinces and territories in Canada (Canadian Food Inspection Agency, 2022).
- H5 HPAI viruses (clade 2.3.4.4b viruses and reassortants of clade 2.3.4.4b and North American lineage viruses) are still detected in wild birds in North America. The prevalence of H5 HPAI viruses within wild bird populations is difficult to estimate; however, its persistence throughout the northern hemisphere summer (Camphuysen and Gear, 2022) and different parts of the region, as reflected by HPAI reports, is suggestive of a relatively high level of circulation among wild bird populations.
- Among the wide spectrum of wild bird species involved in HPAI events in North America since 2021, a significant number of species are considered migratory species, including those in the Anatidae, Accipitridae and Cathartidae families. As a land bridge between North and South America, Central America is a key geographical area for a significant number of medium- to long-distance migratory species. About 15 Anatidae species – accounting for nearly half of H5 HPAI detections in the United States of America – have been observed wintering in Central America, particularly in Mexico (e.g. mallard [*Anas platyrhynchos*], snow goose [*Anser caerulescens*], blue-winged teal [*Spatula discors*], wood duck [*Aix sponsa*], American wigeon [*Mareca americana*], American green-winged teal [*Anas carolinensis*]), the Caribbean and the northern part of South America (Saint-Louis *et al.*, 2021; Convention on Migratory Species, 2022; Cornell Lab of Ornithology, 2022). HPAI outbreaks reported in Mexico in October 2022 involved blue-winged teals, mallards, snow geese and Cooper's hawk (WOAH, 2022).
- In October 2022, Colombia reported its first H5N1 HPAI outbreak in two backyard farms located in a remote area.

The outbreak involved non-poultry domestic birds living together with wild blue-winged teals (*Spatula discors*) (WOAH, 2022). On 11 November 2022, HPAI was introduced into Paita Province, Peru, located about a hundred kilometres from the Ecuadorian border, causing 200 mortalities in a colony of Peruvian pelican (*Pelecanus thagus*) (WOAH, 2022). As Peruvian pelicans mainly live on the coastline of the Andes mountains, it is highly likely that the introduction was caused by migratory wild bird species.

- Other countries, including Panama, Costa Rica, the Cayman Islands and Honduras, have reported H5N1 HPAI infection in wild birds (FAO, 2023).

The likelihood of entry of the H5 HPAI virus into unaffected countries and territories in Central and South America and the Caribbean through migratory bird movements is considered to be **high for all countries**.

The **uncertainty** is considered **medium** given the lack of knowledge on HPAI circulation in bird populations in certain areas of the Americas, the epidemiological role and susceptibility of certain wild bird species, and the complexity of wild bird migration patterns.

Likelihood of exposure

Question 4: *If the H5 HPAI virus enters an unaffected country or territory in Central and South America and the Caribbean, how likely is it that domestic hosts capable of onward spread will be exposed to the virus via the three pathways considered?*

- Several countries in Central and South America and the Caribbean are major worldwide poultry producers, including Mexico and Brazil where intensive poultry production systems are established. Other countries, including Argentina, the Bolivarian Republic of Venezuela, Chile, Dominican Republic, Ecuador, Peru and the Plurinational State of Bolivia are also key players in terms of poultry production in the Americas. This is reflected in the higher density of poultry in those countries (Gilbert *et al.*, 2018a).
- Live poultry production systems and biosecurity:
 - A wide spectrum of poultry production systems is observed throughout the Americas, from family backyard holdings with a few mixed bird species to fully integrated commercial farms with thousands of birds. Generally, levels of biosecurity increase with intensification. Backyard farms, including fighting cocks, tend to be more easily exposed to HPAI virus introduction through wild birds, domestic birds from other farms or villages that often roam around freely, or fomites (animal or feed transporters). For several countries in the Americas, backyard or small-producer farms account for at least 50 percent of the total number of poultry holdings, as per country responses to the questionnaire (e.g. Paraguay with 85 percent, Nicaragua with 99.9 percent and Belize with 60 percent). Nonetheless, commercial farms may also be vulnerable to HPAI virus introduction, through either direct or indirect contact between domestic and wild birds. The presence of accessible fresh water sources and accessible feed may attract significant numbers of wild birds to farms, increasing the likelihood of poultry being exposed to HPAI-infected wild birds.
- Poultry products and by-products:
 - Generally, poultry products and by-products imported from HPAI-affected countries to other partner countries or territories within the Americas go directly for human consumption purposes or are redistributed along the wholesale and retail markets. Therefore, it is unlikely that contaminated products would come into contact with, or be used to feed, local live poultry in unaffected countries and territories in the Americas.
- Capacity for AI detection:
 - Cuba, Paraguay and Suriname indicated a high level of reporting by both small producers and commercial farms, while for Argentina, this applied for commercial farms only.
 - Only Paraguay indicated a high level of reporting by backyard producers, whereas other countries indicated irregular reporting levels (ranging from often to occasional).
 - Only Cuba indicated a high level of reporting by poultry transporters and live bird market traders. Other respondent countries reported lower levels (ranging from never to occasional reporting).
 - There are no passive surveillance programmes for AI in domestic bird populations in any affected responding countries, while active surveillance is implemented in Argentina, Belize, Ecuador, El Salvador, Guatemala, Jamaica, Nicaragua and Paraguay.
 - Among the unaffected countries, active surveillance for AI in wild birds is present in Argentina, Belize, Cuba, Guatemala and Paraguay. The lack of early detection may favour the exposure of live poultry to infected wild birds; and if no mortalities or virus can be detected, it is unlikely that poultry owners will take prevention measures to mitigate contact between wild and domestic birds.
 - Most countries have laboratory capacity for AI virus detection. At least 4 of the 21 countries surveyed obtain AI confirmation diagnosis more than 72 hours after sample reception (Annex A). Coupled with the challenging transportation of field samples, this can lead to significant delays in disease confirmation and increase opportunities for disease spread and exposure of unaffected birds.
- Wild/domestic bird interface:
 - A hotspots analysis based on local indicators of spatial association statistics (Anselin, 1995) was conducted to predict



Chicken farm, Honduras.

wild/domestic bird interfaces at risk of HPAI spillover and transmission from wild to domestic bird species during the wintering period. The spatial distribution of wild bird species richness (Somveille *et al.*, 2013) was estimated from habitat suitability maps (Lumbierres *et al.*, 2022) for species found positive to HPAI viruses in the Americas, while the domestic bird distribution was estimated from the poultry distribution of the FAO Gridded Livestock of the World (Gilbert *et al.*, 2018b). Figure 2a shows significant interfaces (hotspots) between all wild bird species positive to HPAI (total species richness) and domestic birds (red areas) during the wintering period in southeastern parts of the United States of America; in the Caribbean; along most of Mexico, Belize, Costa Rica, Guatemala, Honduras, Nicaragua and Panama; as well as in northern Colombia, northwestern Ecuador and the northern region of the Bolivarian Republic of Venezuela. As shown by Somveille *et al.* (2013), these areas are particularly rich in wintering migratory species. Small hotspots are also predicted along the coastal areas of Guyana and Suriname as well as along the eastern coast of Argentina and Brazil. Large areas unsuitable for the co-occurrence of wild and domestic birds (cold spots) during the wintering season are shown in blue and are mainly predicted in North America, the Amazon basin, along the Andes and in Patagonia. Figure 2b shows an interface map predicted from the Anatidae species richness and domestic birds, highlighting significant hotspots in southern and western sides of Cuba, Mexico and the United States of America but not in northern South America.

The likelihood of domestic birds being exposed and subsequently infected with the H5 HPAI virus once it has entered an unaffected country/territory through one of the previously assessed entry pathways is considered:

Formal and informal trade of live birds:

- Low for live birds (except fighting cocks) in all countries as most of the live poultry imported is day-old chicks destined for breeding farms (not live bird markets), whereas ornamental birds are distributed to pet shops and exhibition centres.
- Moderate for informal importation of fighting cocks in all countries as these cocks are kept in backyards or village farms with possible exposure to other domestic poultry. Furthermore, they are transported between villages and cities to participate in several fights.

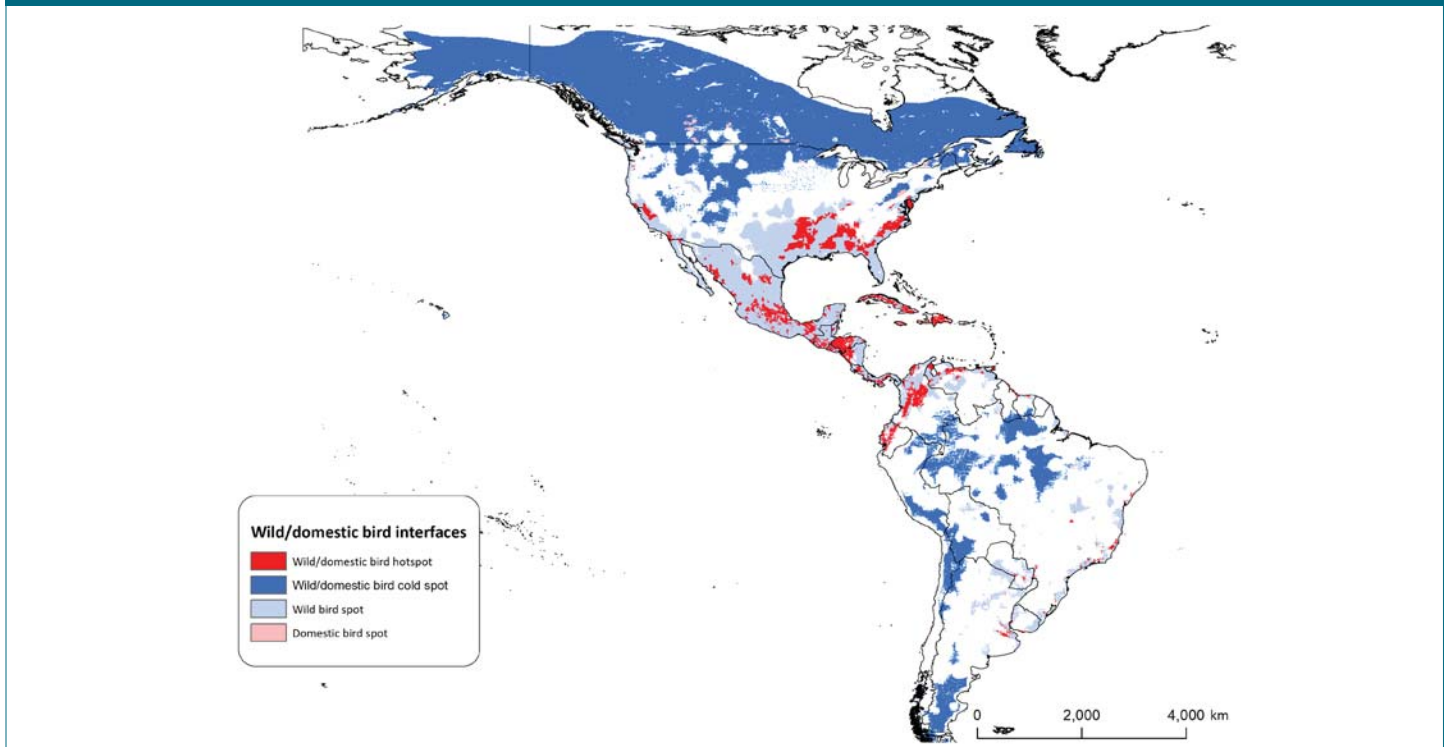
Formal and informal trade of poultry products:

- Very low for all countries as imported poultry products are destined for hatcheries (fertile eggs), processing plants (feed meals of poultry origin such as feather, bones, etc.), or markets for human consumption (table eggs, poultry meat).

Migratory birds:

- High for Central American countries, Bolivia, Brazil, French Guiana, Guyana, and Suriname, and several countries and territories in the Caribbean, including Aruba, Cuba, Curaçao, the Dominican Republic, Haiti and Puerto Rico; and moderate for all other South American and Caribbean countries and territories. This is due to various risk factors, including the distribution of hotspots for wild/domestic bird interfaces, chicken density in different countries, the presence of backyard and small production farms with very low to low levels of biosecurity, lack of qualified human resources for wild bird surveillance, AI surveillance in domestic birds, and diagnostic limitations.
- The uncertainty is considered medium.

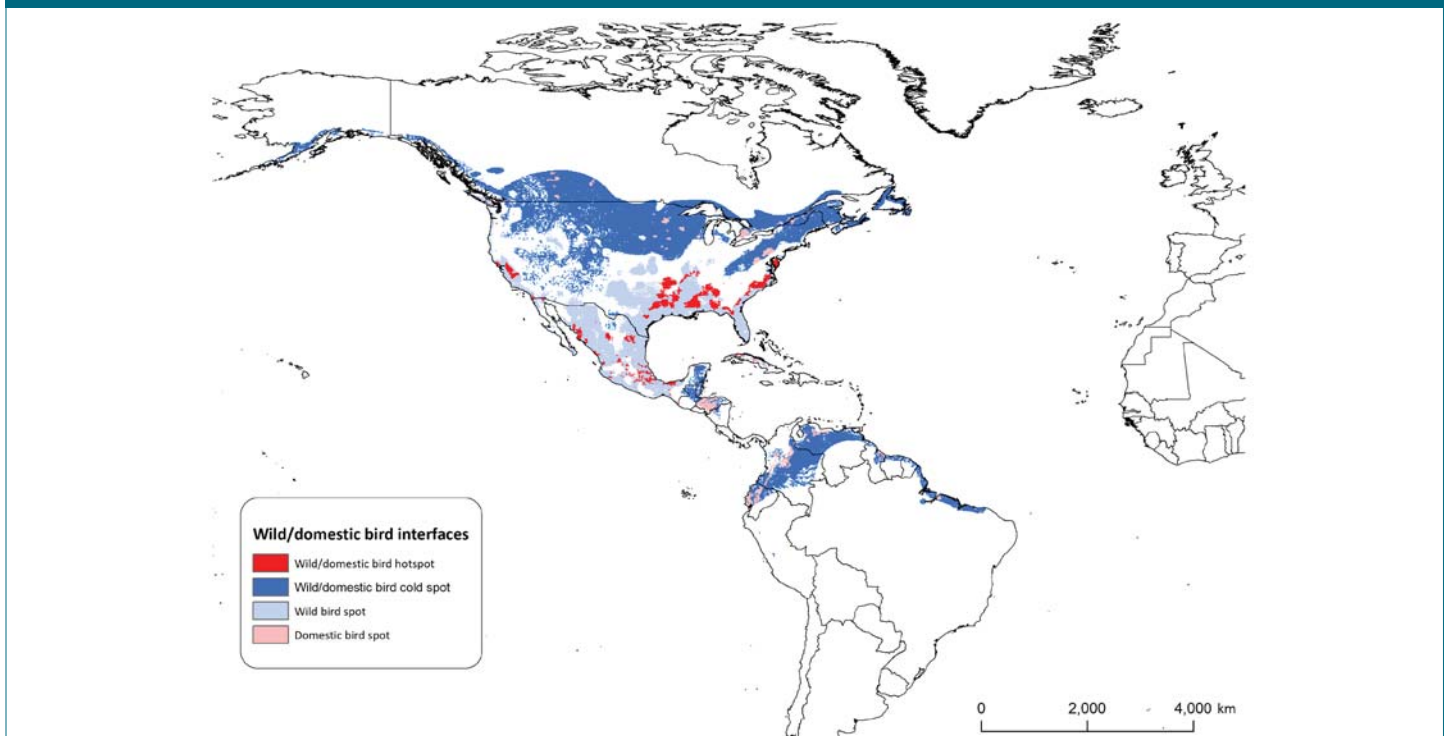
FIGURE 2a: Predicted wild/domestic bird interface for HPAI spillover during the wintering period based on: total species richness



Source: United Nations Geospatial. 2020. Map of the world. United Nations. Cited 7 December 2022. www.un.org/geospatial/file/3420/download?token=TUP4yDmF, modified with data and interface model elaborated by FAO NSAH.

Disclaimer: The boundaries and names shown and the designations used on these map(s) do not imply the expression of any opinion whatsoever on the part of FAO concerning the legal status of any country, territory, city or area or of its authorities, or concerning the delimitation of its frontiers and boundaries.

FIGURE 2b: Predicted wild/domestic bird interface for HPAI spillover during the wintering period based on: anatidae species richness



Source: United Nations Geospatial. 2020. Map of the world. United Nations. Cited 7 December 2022. www.un.org/geospatial/file/3420/download?token=TUP4yDmF, modified with data and interface model elaborated by FAO NSAH.

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ECONOMIC IMPACT OF HPAI IN CENTRAL AND SOUTH AMERICA AND THE CARIBBEAN

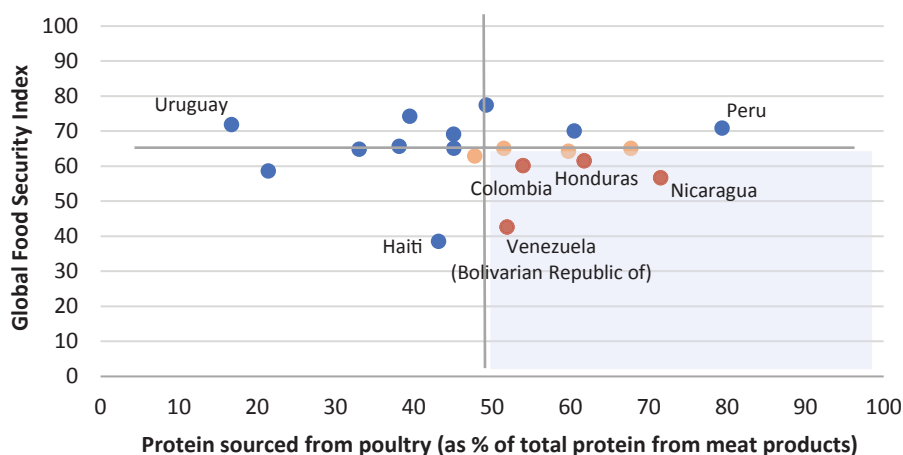
HPAI has devastating consequences for the poultry industry, farmers' livelihoods, job opportunities, global food security and the health of wild birds. Poultry production is an economically important and growing sector in South America. The region is one of the largest exporters of poultry meat in the world and accounts for more than a fifth of poultry globally (FAO, 2022c). Poultry meat and products are food staples and are important components for food security in the region. Moreover, backyard poultry production is considered important or very important in 17 of the 21 responding countries in the Americas since many vulnerable communities rely on this type of production for subsistence. Considering the high morbidity and high mortality rates linked to HPAI, direct losses in infected poultry may have severe impacts on all affected flocks.

The stamping out of infected and in-contact flocks, as per WOHAI international standards, carries a high economic cost and creates stress for the poultry industry and the livelihoods involved. For example, in the United States of America, about 53 million poultry have been culled since the first report in domestic birds in February 2022 (USDA APHIS, 2022). In 2004, Canada spent an estimated USD 380 million to contain an H7N3 HPAI outbreak in British Columbia involving 17 million birds (Pasick *et al.*, 2009). While in 2012, an outbreak in Mexico resulted in the death through disease or culling of over 22 million birds at an estimated cost of over USD 720 million (Kapczynski *et al.*, 2013). During the H5N2 HPAI epizootic in 2014–2015, the United States spent nearly USD 1 billion to cover costs for depopulation, cleaning, disinfection and indemnities for lost birds, as reported by [Johansson *et al.* \(2016\)](#).

Trade bans or restrictions imposed on countries affected by HPAI place additional economic strain on the poultry industry. Changes in supply and demand can be observed in affected countries, with commodities seeing sharp price increases or drops depending on the context, as seen in the United States of America with prices of table eggs and broilers (Ramos, MacLachlan & Melton, 2017). Given the impacts previously observed in countries affected by HPAI, should the disease spread widely in countries in the Americas, this could severely disrupt the regional market. Reduced supply of poultry meat and eggs in major producers, associated with an increase in prices, will affect net importer countries and territories in the region where populations are generally more vulnerable.

FAOSTAT food balances and the GFSI were used to identify countries that rely on poultry meat as an important source of protein and are at risk from food insecurity. The combination of these two indicators allows us to identify populations that are highly vulnerable to food insecurity due to HPAI for a sample of 19 countries from Central and South America and the Caribbean. The Bolivarian Republic of Venezuela was identified as the most highly vulnerable to food insecurity due to HPAI, followed by Colombia, Honduras, Nicaragua and, to a lesser extent, the Plurinational State of Bolivia, the Dominican Republic, El Salvador and Guatemala (orange dots) (Figure 3). Poultry meat preference over other types of meat is also very high in other countries, including Jamaica (85 percent), Guyana (78 percent), Saint Vincent and the Grenadines (78 percent), Suriname (77 percent), and Trinidad and Tobago (77 percent). These countries are therefore potentially highly vulnerable, despite there being no GFSI available to include them in the analysis.

FIGURE 3: South and Central American and Caribbean countries' vulnerability to food insecurity due to HPAI



Source: FAOSTAT and the Global Food Security Index (GFSI).

Brazil, Colombia, the Dominican Republic, Mexico and the Plurinational State of Bolivia and several other countries in the Americas have large poultry industries that generate thousands of direct and indirect jobs. The Brazilian Association for Animal Protein estimates that there are currently around 350 000 direct jobs involved in the Brazilian poultry production chain, which, including indirect jobs, accounts for nearly 3.5 million jobs (Campos, 2016). Costa Rica and Guatemala have around 100 000 and 385 000 persons directly or indirectly employed in the poultry sector respectively. Given these numbers, it becomes obvious that any strain on poultry production caused by the spread of HPAI, stamping-out or trade bans, among others, would lead to negative impacts on employment, with potential major job losses in the poultry industry.

DISCUSSION

This qualitative risk assessment was conducted with data available up to January 2023. It aims to shed light on high-risk pathways for H5 HPAI virus introduction and guide policy interventions to mitigate the risk in unaffected countries and territories in Central and South America and the Caribbean. While primary data was available from 21 countries via the questionnaire, detailed data was unavailable for many countries in the region. Uncertainty levels reflect this lack of data. Substantial knowledge gaps in relation to AI remain, as highlighted in the FAO EMPRES 360 publication on avian influenza (FAO, 2022d), especially regarding the principal transmission pathways between wild birds and commercial or backyard poultry, in both directions. There are still many opportunities for knowledge improvement in a wide range of topics.

The timeline for risk awareness from this risk assessment spans 1 January to 1 March 2023, i.e. until approximately when migratory wild birds start their journey back from wintering areas (southern latitudes) to breeding grounds (northern latitudes). However, this does not exclude the occurrence of additional H5 HPAI outbreaks in Central America, South America or the Caribbean from March onwards. This will likely depend on the course of H5 HPAI virus spread and persistence in wild and domestic bird populations in the region, particularly in newly affected countries in Central America and northern parts of South America.

While the impact assessment was focused on the production and economic aspects, it is important to mention the impacts on wildlife, ecosystems and human populations. The circulation of the H5 HPAI virus in new areas of Central America and South America has resulted in virus spillover into local and endemic wild bird species susceptible to the virus, such as yellow-crowned parrots (*Amazona ochrocephala*), scarlet macaws (*Ara macao*) and Peruvian pelicans (*Pelecanus thagus*). In the latter species, at least 200 birds were found dead at the outbreak location in Peru. There are reports of other species of pelicans infected in

Costa Rica, Honduras and Panama, highlighting the relative higher risk for certain species, particularly those threatened with extinction or under conservation efforts. With regards to mammals, H5 HPAI events have also been reported over the past few years in Europe and North America in species such as seals, foxes and skunks, which suggests that similar events could be observed should HPAI spread more widely into wild bird populations in Central America or South America.

Currently circulating H5Nx HPAI viruses in the Americas that fall within the clade 2.3.4.4b of the A/goose/Guangdong/1/1996 lineage have already demonstrated zoonotic potential. Most – if not all – influenza A(H5) human cases reported had direct or indirect exposure to sick live or dead poultry.

In this regard, it is essential that countries ensure appropriate protection of the personnel managing poultry outbreaks to prevent any zoonotic spillover.

RECOMMENDATIONS FOR PREVENTION AND CONTROL OF HPAI

The HPAI situation may quickly escalate in affected countries, particularly those experiencing its introduction for the first time. FAO has developed several manuals on preparing for HPAI to assist in prompt recognition and detection of the disease in domestic and wild birds through surveillance, the establishment of immediate control steps at farm level, and good practices for biosecurity in farms and live bird markets. Annex C provides a list of FAO manuals and guidelines in relation to HPAI prevention and control, or emergency preparedness and response.

FAO recommends that countries and territories:

- Conduct their own risk assessments to more specifically identify potential hotspots for H5 HPAI virus entry and exposure risks at the national level.
- Increase early warning surveillance efforts in areas identified to be at higher risk of HPAI introduction through wild birds (particularly ducks, geese and other water birds as well as raptors and scavenging birds), e.g. areas located along migratory flyways, by immediately testing sick or dead poultry as well as dead/hunted wild birds for the presence of HPAI viruses.
- Limit direct and indirect contact between domestic poultry and wild birds (e.g. keep poultry indoors, use fences or nets to reduce contact between domestic poultry and wild birds); pay particular attention to sources of poultry drinking water to ensure it cannot be contaminated or it is treated appropriately before use.
- Ensure implementation of biosecurity measures along the poultry value chain, including farms, especially those in close proximity to wild bird habitats, to limit further spread of the disease.
- Ensure contingency plans for outbreak response are reviewed and tested.

- Ensure the preparedness of veterinary services and availability of resources for the humane culling and disposal of large numbers of poultry.
- Additional recommendations on measures targeting the various risk pathways for HPAI entry and exposure are available in Annexes D, E and F and at www.fao.org/3/cc1998en/cc1998en.pdf.
- Once an outbreak has occurred, additional measures to prevent further spread:
 - Implement rapid movement control in the affected area and establish infected and buffer zones.
 - Conduct epidemiological investigations and tracing to determine high-risk contacts.
 - Develop and implement a surveillance plan to detect spread.
 - Implement rapid and humane depopulation of poultry as per country regulations.
 - Quickly and safely collect and dispose of carcasses of dead poultry/wild birds (Miller, Miknis and Flory, 2020).
 - Prevent spread between domestic and wild birds (please see [FAO guidance on biosecurity for HPAI](#)).
 - Conduct surveillance in wild birds through cooperation with wildlife keepers, foresters and hunters.
 - Implement biosecurity measures to limit contact between domestic and wild birds.
 - It is also strongly recommended to ban cockfighting, pigeon racing and other avian concentrations in the outbreak area.
 - Establish rapid diagnostic capabilities to enable early detection (each country should determine the diagnostic needs in terms of items and quantities, at least during the emergency phase after the introduction).
 - National laboratory capacity to conduct rapid HPAI testing and subtyping is essential for early detection and response. As a second step, confirmation by a national or regional reference laboratory should be sought to confirm initial diagnosis. Further antigenic and genetic characterization, along with phylogenetic analyses of any HPAI virus isolate, is recommended. While the capacity may not necessarily be available at the national level, it

- can be outsourced to partner or reference laboratories.
- Institute incident command and communication procedures.
- Undertake public awareness campaigns and poultry stakeholder communication.

FAO SUPPORT TO COUNTRIES

FAO actions to support Member Nations include:

- Monitoring and assessing the evolving disease situation and conducting regular risk assessments as needed. To share updates on your country situation, please contact FAO at FAO-GLEWS@fao.org.
- Liaising with FAO/WOAH reference laboratories and partner organizations to assess virus characteristics and provide laboratory protocols for detection.
- Raising awareness about important epidemiological and virological findings and their implications.
- Building capacities of animal health authorities by providing online training covering AI epidemiology, detection, prevention and control. Please contact VLC-Global@fao.org if you need a training course for your subregion/region.
- Providing evidence-based recommendations, and technical guidance for affected and at-risk countries/territories addressing surveillance, biosecurity management, risk communication and disease control. Contact EMPRES-Animal-Health@fao.org.
- Providing support for risk assessment and mapping to identify hotspots for risk mitigation and the implementation of risk-based surveillance.
- Offering support in the provision of diagnostic reagents and personal protective equipment, provided certain conditions are met. Contact EMPRES-Lab-Unit@fao.org.
- Offering assistance to national authorities for sample shipment and virus subtyping and sequencing, provided certain conditions are met. Contact EMPRES-Shipping-Service@fao.org.
- For emergency management support, contact the FAO Emergency Management Centre through a request from the relevant FAO country office. Contact EMC-AH@fao.org.



Cormorants on the Rupununi river, Guyana.

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ANNEX A

Data extracted from the questionnaire survey obtained from 21 countries in Central and South America and the Caribbean, gathered between August and October 2022

Country	Preparedness for							Lab tests (ALL= PCR and serology)	Average interval (day)		Case definition suspected/confirmed	Communicating case definition	Time (years) since last training on			Inspection of travellers at points of entry	Qualified inspectors at points of entry	Active surveillance of wild birds	Human resources for wild bird surveillance	Inspection of transit vehicles	Contact of poultry industry workers with other poultry after work
	Importation of live poultry/its products	Emergency regulations	Laboratory diagnosis	Quarantine and movement control	Risk assessment	Field surveillance	Cleaning and disinfection		Sample collection and submission to labs	Receiving sample and lab diagnosis			AI clinical diagnosis	Sampling for HPAI	Environmental sampling for HPAI						
Argentina	VH	VH	H	VH	H	VH	VH	All	<2	1	Yes	Yes	<2	<2	Never	Yes	Yes	Yes	Yes	Yes	-
Belize	VH	M	H	VH	H	M	VH	All	<2	3	Yes	Yes	3–4	3–4	Never	Yes	Yes	Yes	No	No	Yes
Brazil	VH	H	H	VH	M	H	H	All	<2	1	Yes	Yes	<2	<2	3–4	Yes	Yes	No	No	Yes	Yes
Chile	VH	VH	VH	VH	H	VH	VH	All	<2	1	Yes	Yes	<2	<2	<2	Yes	Yes	Yes	Yes	No	Yes
Costa Rica	VH	VH	M	H	H	H	VH	All	<2	2	Yes	Yes	3–4	3–4	Never	Yes	Yes	No	No	No	Yes
Cuba	VH	H	H	VH	VH	H	L	All	<2	0	Yes	Yes	3–4	3–4	3–4	Yes	Yes	Yes	Yes	Yes	Yes
Curaçao	VL	VL	VL	VL	M	VL	H	ELISA	<2	1	No	No	<2	<2	3–4	Yes	Yes	No	No	No	-
Ecuador	L	H	H	H	VL	M	L	All	<2	8	Yes	Yes	<2	<2	3–4	Yes	Yes	No	No	Yes	Yes
El Salvador	L	M	M	M	H	H	L	All	<2	1	Yes	Yes	<2	<2	<2	Yes	Yes	No	No	No	Yes
Guatemala	M	H	H	H	M	H	H	All	7–9	7–9	Yes	Yes	<2	<2	Never	Yes	Yes	Yes	Yes	Yes	Yes
Honduras	L	H	M	M	VL	H	M	All	<2	3	Yes	No	3–4	3–4	Never	Yes	Yes	No	Yes	No	Yes
Jamaica	VH	M	M	M	VL	M	H	All	<2	2	Yes	No	<2	3–4	3–4	Yes	Yes	No	No	No	-
Mexico	VH	VH	VH	VH	VH	VH	M	All		1	Yes	No	<2	<2	3–4	Yes	Yes	Yes	Yes	Yes	No
Nicaragua	VH	H	H	H	H	H	VH	All	<2	3–7	Yes	Yes	<2	<2	Never	Yes	Yes	No	Yes	Yes	-
Paraguay	L	H	H	H	H	H	H	All	<2	1	Yes	Yes	<2	<2	<2	Yes	Yes	Yes	Yes	yes	Yes
Peru	L	H	M	M	VH	VH	H	All	<2	1–3	Yes	Yes	<2	<2	Never	Yes	Yes	No	No	Yes	No
Suriname	L	H	M	H	H	H	H	-	<2	1	Yes	Yes	3–4	3–4	3–4	-	Yes	No	No	Yes	Yes
Trinidad and Tobago	M	M	M	M	M	M	VH	All	<2	7–14	Yes	Yes	3–4	3–4	3–4	Yes	Yes	No	No	No	Yes
Uruguay	VH	VH	H	M	VH	M	M	All	<2	1	Yes	No	1	3–4	3–4	Yes	Yes	No	No	No	-

ANNEX B Summary table for the likelihood and uncertainty levels per each country/territories or area

serial	Country	Subregion	Formal and informal importation of live birds			Formal and informal importation of poultry products			Informal importation of fighting cocks			Movement of migratory birds		
			Entry	Exposure	Risk of introduction	Entry	Exposure	Risk of introduction	Entry	Exposure	Risk of introduction	Entry	Exposure	Risk of introduction
1	Anguilla	Caribbean	L	L	N	L	VL	N	L	M	L	H	M	M
2	Antigua and Barbuda	Caribbean	L	L	N	L	VL	N	L	M	L	H	M	M
3	Aruba	Caribbean	L	L	N	L	VL	N	L	M	L	H	H	H
4	Bahamas	Caribbean	L	L	N	L	VL	N	L	M	L	H	M	M
5	Barbados	Caribbean	L	L	N	L	VL	N	L	M	L	H	M	M
6	Bonaire, Sint Eustatius and Saba	Caribbean	L	L	N	L	VL	N	L	M	L	H	M	M
7	British Virgin Islands	Caribbean	L	L	N	L	VL	N	L	M	L	H	M	M
8	Cayman Islands	Caribbean	L	L	N	L	VL	N	L	M	L	H	M	M
9	Cuba	Caribbean	VL	L	N	VL	VL	N	L	M	L	H	H	H
10	Curaçao	Caribbean	M	L	L	M	VL	L	L	M	L	H	H	H
11	Dominica	Caribbean	L	L	N	L	VL	N	L	M	L	H	M	M
12	Dominican Republic	Caribbean	L	L	N	L	VL	N	L	M	L	H	H	H
13	Grenada	Caribbean	L	L	N	L	VL	N	L	M	L	H	M	M
14	Guadeloupe	Caribbean	L	L	N	L	VL	N	L	M	L	H	M	M
15	Haiti	Caribbean	L	L	N	L	VL	N	L	M	L	H	H	H
16	Jamaica	Caribbean	VL	L	N	VL	VL	N	L	M	L	H	M	M
17	Martinique	Caribbean	L	L	N	L	VL	N	L	M	L	H	M	M
18	Montserrat	Caribbean	L	L	N	L	VL	N	L	M	L	H	M	M
19	Puerto Rico	Caribbean	L	L	N	L	VL	N	L	M	L	H	H	H
20	Saint Barthélemy	Caribbean	L	L	N	L	VL	N	L	M	L	H	M	M
21	Saint Kitts and Nevis	Caribbean	L	L	N	L	VL	N	L	M	L	H	M	M
22	Saint Lucia	Caribbean	L	L	N	L	VL	N	L	M	L	H	M	M
23	Saint Martin (French Part)	Caribbean	L	L	N	L	VL	N	L	M	L	H	M	M
24	Saint Vincent and the Grenadines	Caribbean	L	L	N	L	VL	N	L	M	L	H	M	M
25	Sint Maarten (Dutch part)	Caribbean	L	L	N	L	VL	N	L	M	L	H	M	M
26	Trinidad and Tobago	Caribbean	VL	L	N	VL	VL	N	L	M	L	H	M	M
27	Turks and Caicos Islands	Caribbean	L	L	N	L	VL	N	L	M	L	H	M	M
28	United States Virgin Islands	Caribbean	L	L	N	L	VL	N	L	M	L	H	M	M
29	Belize	Central America	VL	L	N	VL	VL	N	L	M	L	H	H	H
30	Costa Rica	Central America	VL	L	N	VL	VL	N	L	M	L	H	H	H
31	El Salvador	Central America	VL	L	N	H	VL	N	L	M	L	H	H	H
32	Guatemala	Central America	VL	L	N	VL	VL	N	L	M	L	H	H	H
33	Nicaragua	Central America	L	L	N	L	VL	N	L	M	L	H	H	H
34	Argentina	South America	L	L	N	L	VL	N	L	M	L	H	M	M
35	Bolivia (Plurinational State of)	South America	L	L	N	L	VL	N	L	M	L	H	H	H
36	Brazil	South America	VL	L	N	VL	VL	N	L	M	L	H	H	H
37	Falkland Islands (Malvinas)*	South America	L	L	N	L	VL	N	L	M	L	H	M	M
38	French Guiana	South America	L	L	N	L	VL	N	L	M	L	H	H	H
39	Guyana	South America	L	L	N	L	VL	N	L	M	L	H	H	H
40	Paraguay	South America	VL	L	N	VL	VL	N	L	M	L	H	M	M
41	South Georgia and the South Sandwich Islands	South America	L	L	N	L	VL	N	L	M	L	H	M	M
42	Suriname	South America	L	L	N	L	VL	N	L	M	L	H	H	H
43	Uruguay	South America	VL	L	N	VL	VL	N	L	M	L	H	M	M

Red font: countries targeted by the questionnaire survey. Blue cells: high uncertainty. Green cells: medium uncertainty.

* A dispute exists between the Governments of Argentina and the United Kingdom concerning sovereignty over the Falkland Islands (Malvinas).

ANNEX C List of FAO resources on HPAI prevention and control and emergency response

Guidance and manuals	<ul style="list-style-type: none"> • FAO Alert for Central America and South America: H5 highly pathogenic avian influenza – risk for introduction and spread, 13 September 2022 – English, French and Spanish • Preparing for highly pathogenic avian Influenza (FAO Animal Production and Health Manual No. 3 – 2006) – English, Spanish and multiple other languages • Biosecurity for highly pathogenic avian influenza (FAO Animal Production and Health Paper No. 165 – 2008) – English and French • Biosecurity guide for live poultry markets (FAO Animal Production and Health Guidelines No. 17 – 2015) – English and French • Wild birds and avian influenza (FAO Animal Production and Health Manual No. 5 – 2007) – English, French and multiple other languages • Wild bird highly pathogenic avian influenza surveillance (FAO Animal Production and Health Manual No. 4 – 2006) – English, French and multiple other languages • Humane Slaughter Association – Online guide for human killing methods available for species and their suitability for circumstances. Recommended methods for killing poultry. www.hsa.org.uk/killing-poultry/killing-poultry • Carcass management guidelines (FAO Animal Production and Health Guidelines No. 23 – 2006) – English, French, Spanish and multiple other languages • Good emergency management practice: The essentials (FAO Animal Production and Health Manual No. 25 – 2021) – English and Spanish • Manual for the management of operations during an animal health emergency (FAO Animal Production and Health Manual No. 27 – 2022) – English and French • Compensation programs for the sanitary emergence of HPAI-H5N1 in Latin America and the Caribbean (FAO Animal Production and Health Manual No. 6 – 2008) – English and Spanish • FAO EMPRES Focus on: Rational use of vaccination for control and prevention of H5 highly pathogenic avian influenza (EMPRES FOCUS ON Vol. 10 – May 2016) – English and French • EMPRES Animal Health 360: Avian influenza: information must improve effective interventions – English
Websites	<ul style="list-style-type: none"> • Global avian influenza virus with zoonotic potential situation update (available through email distribution; if interested please contact: EMPRES-Livestock@fao.org) • USDA Animal and Plant Health Inspection Service (APHIS): 2022–2023 detections of highly pathogenic avian influenza • Canadian Food Inspection Agency: Response to detections of avian influenza in Canada • Joint WOAHP-FAO Network of Expertise on Animal Influenza (OFFLU) website • World Health Organization avian influenza page • WOAHP avian influenza page • World Health Organization vaccine composition meeting report – September 2022

ANNEX D Preventive measures targeting major risk pathways for H5 HPAI virus entry into a country

Risk pathways for HPAI virus entry	Preventive measures
Infected live birds or contaminated poultry products through formal/informal trade	<ul style="list-style-type: none"> • Import from HPAI-free countries, zones or compartments only. • Strictly follow the WOAHP Terrestrial Code for the import of live poultry and poultry products or related commodities. Only allow import of products from HPAI-free countries, zones or compartments (for details on compartmentalization see chapters 4.4 and 4.5 of the WOAHP Terrestrial Code). • Conduct risk assessments of potential sources/pathways of infected live bird movements, based on known patterns of formal import and intelligence on informal movement of people, live poultry and poultry products. FAO guidelines on rapid risk assessment are available. Be aware of the lag time between initial cases and official reporting of the disease, which has occurred in many countries (sometimes up to several weeks). This might mean that the national borders of your country/territory have been vulnerable to inadvertent importation of infected live poultry or poultry products. • Conduct socioeconomic and environmental impact assessments and food security analysis. • Strengthen regional cooperation and information-sharing systems for early reporting of suspect cases. • Reinforce border inspection capacities, including by: <ul style="list-style-type: none"> – enforcing fines, penalties or disincentives for smugglers; – improving the detection of animal products at points of entry (e.g. deploying scanners or sniffer dogs for meat detection); and – ensuring full collaboration among law enforcement and authorities, including customs, port management, airport management, coast guards, international post office and international couriers. • Raise awareness among relevant stakeholders (e.g. farmers, veterinarians, hunters) and the general public through information campaigns via several communication channels (e.g. social media, television, radios, posters).
Fighting cocks	<ul style="list-style-type: none"> • Prevent participation from the outbreak areas (affected countries) in practices/events involving contact between birds from different areas/communities, such as cockfighting, pigeon racing and other avian concentrations.
Wild birds	<ul style="list-style-type: none"> • Restrict the practices associated with potential wild bird infection, such as: <ul style="list-style-type: none"> – disturbing wild bird habitat areas; – using poultry cuts as fishing bait near wild bird areas; and – establishing poultry farms near wild bird areas. • Immediately report wild bird mortalities to the authorities.

ANNEX E Preventive measures targeting major risk pathways for poultry exposure to H5 HPAI virus

Risk pathways for HPAI virus exposure	Preventive measures
Exposure of domestic birds (including captive birds)	<p>Biosecurity improvement along the poultry value chain (FAO, OIE and World Bank, 2009):</p> <ul style="list-style-type: none"> • Restrict visitor access, particularly those who have regular access to agricultural sites or who have engaged in hunting activities. • Clean and disinfect equipment, vehicles, boots/shoes, pens, barns and other premises. • Poultry farm workers should not keep poultry from their own farms at home or hunt wild birds. • Provide a change of footwear and clothing for workers at farm entrances. • Prohibit vehicles entering farm gates or disinfect (tyres of) vehicles. • Concerning backyard farmers, divide poultry areas and change footwear and clothing before contact with poultry. • Provide adequate ablution facilities for workers. • Wash hands before and after handling poultry. • Protect water and feed sources from access by wild birds. • Do not clean facilities with water that is potentially contaminated with wild bird droppings. • If any equipment is shared with poultry-keeping neighbours, it should be thoroughly cleaned and disinfected before coming into contact with poultry. • New poultry should come from trusted sources and be isolated for at least 15 days before being introduced to the rest of the flock. • In countries where live/wet markets exist, they should be regulated, with defined intervals for cleaning and disinfection.

NOTES



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RISK ANALYSIS IN ANIMAL HEALTH

Risk analysis is a procedure, which we all do intuitively in our everyday life as we also do in our professional work to assess the risk of any hazard or threat. In animal health, risk analysis has been most widely used as a decision tool to help select the most appropriate health interventions to support disease control strategies, guide disease surveillance and support disease control or eradication strategies.

It should be remembered that risk is not equal to zero and never stays static. Risk changes as drivers or factors of disease emergence, spread or persistence change such as intensification of livestock production, climate change, civil unrest and changes in international trading patterns. Risk analysis should therefore not be seen as a “one off” but as good practice for animal health systems as part of their regular activities. Therefore, risk analysis process should be repeated and updated regularly.

Risk analysis comprises the following components:



Hazard identification: the main threats are identified and described.



Risk assessment: risks of an event occurring and developing in particular ways are first identified and described. The likelihood of those risks occurring is then estimated. The potential consequences or impact of the risks if they occur are also evaluated and are used to complete the assessment of the risk.



Risk management: involves identifying and implementing measures to reduce identified risks and their consequences. Risk can never be completely eliminated but can be effectively mitigated. The aim is to adopt procedures that will reduce the level of risk to what is deemed to be an acceptable level.



Risk communication: an integrated process that involves and informs all stakeholders within the risk analysis process and allows for interactive exchange of information and opinions concerning risk. It assists in the development of transparent and credible decision-making processes and can instil confidence in risk management decisions.

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Contributors

Xavier Roche, Caryl Lockhart, Ryan Aguanno, Ihab El-Masry, Emma Gardner, Claudia Pittiglio, Giuseppina Cinardi, Alessandra Alvit, Ismaila Seck, Akiko Kamata, Hernan Rojas, Andreas Gonzalez, Madhur Dhingra and Keith Sumption.

Food and Agriculture Organization of the United Nations (FAO)

External peer-reviewers

Sherrilyn Wainwright and Paul Egrie from *USDA-APHIS*; Sharon Calvin from *Public Health Agency of Canada*.

Contact

For any queries or questions regarding this issue of the assessment please write to EMPRES-animal-health@fao.org

