



H5N1 HPAI spread in Nigeria and increased risk for neighbouring countries in West Africa

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Summary

On 16 January 2015, Nigeria confirmed the presence of H5N1 HPAI to the World Organisation for Animal Health (OIE). This was the first occurrence of H5N1 HPAI in the country since the last epidemic between 2006 and 2008. The virus involved is similar to recent isolates taken from birds in Bulgaria, India and Viet Nam as well as an environmental sample from China. The disease has so far spread to nearly 400 enterprises including live bird markets (LBMs) and farms in 9.1% (71 out of 775) local government areas (LGAs) in 48.6% (18 out of 37) states across Nigeria. While the Nigerian Government has responded by implementing quarantine, culling and compensation, outbreaks continue to be reported. Agro-ecological drivers of HPAI H5N1 similar to those present in endemic regions of South East Asia are present in Nigeria and West

Africa, thus implying an increased risk of disease spread in the region. Traditional trading patterns, both formal and informal, between Nigeria and neighbouring countries provide an opportunity for cross-border or inter-regional disease spread. The recent incursion into Burkina Faso only emphasizes this potential risk. Currently, countries at immediate risk of spread are Benin, Cameroon, Chad, Ghana, the Niger and Togo. Other countries that had reported outbreaks in the past are also at risk. These include the Republic of Côte d'Ivoire, Djibouti and the Sudan. These countries need to prepare to detect and respond in a timely manner to possible incursions of the disease.

H5N1 HPAI situation in Nigeria

Following a global wave of HPAI H5N1 spread with newly affected countries including Bulgaria, Germany, the Netherlands, Nigeria, Palestine and the United States of America, OIE confirmed the presence of H5N1 HPAI in Nigeria on 16 January 2015. This was the first occurrence of H5N1 HPAI in the country since the last epidemic between 2006 and 2008. This event is particularly critical given the importance of the Nigerian poultry population to livelihoods and food security in Nigeria, and the potential risk of spread to countries in the region. The previous outbreak in Nigeria began in early 2006 and resulted in 25 out of 37 states affected, the destruction of 160 million poultry and approximately US\$5.4 million paid in compensation by the Government of Nigeria. HPAI H5N1 outbreaks also spread to other countries in Africa including Benin, Burkina Faso, Cameroon, Djibouti, the Niger, the Republic of Côte d'Ivoire and the Sudan.

Current outbreak situation

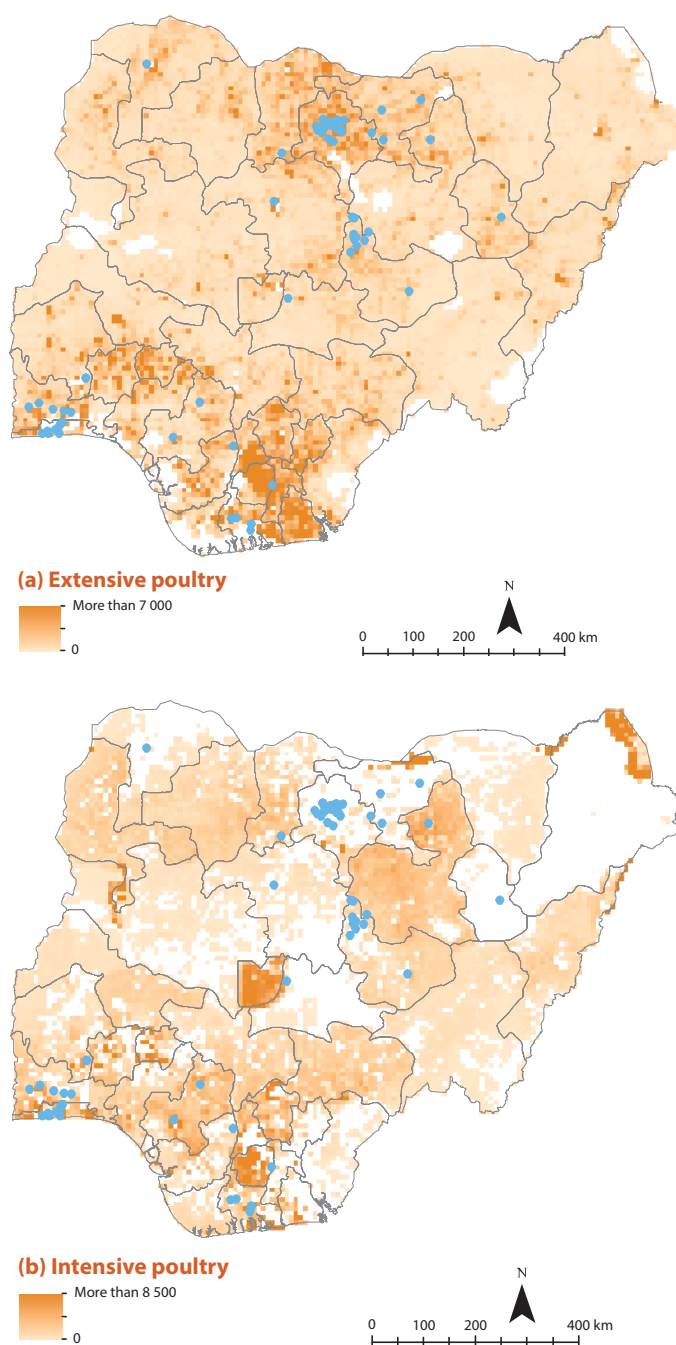
The first reported case with an onset date of 2 January 2014 occurred on a farm in the local government area of Dala in Kano State. The disease killed approximately 1 500 birds. The virus was detected six days later approximately 12 kilometres from this site, on a farm in Kumbotso, Kano State. As of 13 April 2015, the disease has spread to over 401 enterprises including LBMs and farms in 9.8 percent (76 out of 775) LGAs in 48.6 percent (18 out of 37) states across Nigeria. The most affected areas are located in the central, north and southwest regions, mirroring the concentration of poultry populations in the country. In terms of the percentage of affected LGAs, the states of Kano (44 percent), Plateau (27 percent), Bauchi and Kaduna (6 percent both) are most affected.

The H5 of the current virus strain in Nigeria was identified as belonging to Clade 2.3.2.1c (result based on one isolate only). The HA gene clusters with H5 viruses collected in China in 2013 and with an H5N1 virus (A/Alberta/01/2014) isolated from a Canada resident who had returned from China and likely got infected there (Monne *et al.*, 2015). Clade 2.3.2.1c viruses were reported from several Asian countries in recent years and this clade has been associated in early 2015 with H5N1 cases in wild birds and poultry reported from Bulgaria and wild birds in Romania. The source of incursion of this H5N1 virus into Nigeria is difficult to determine and may have been related to the informal poultry trade in Nigeria or migratory bird movements.

The Government of Nigeria has responded by implementing quarantine, culling and compensation.

FAOSTAT estimated the susceptible poultry population at risk in Nigeria for 2010

Figure 1. Centroid location of HPAI H5N1 outbreaks in LGAs in Nigeria from January to February 2015 superimposed over (a) extensive and (b) intensive poultry densities defined as the number of poultry per square kilometre.



was approximately 165 million birds including chickens and ducks, but review of more recent unofficial information sources suggests that this figure was an underestimate. Nigeria is considered a major egg producer and the fourth target broiler producer in the region. Table 1 shows the estimated chicken populations for Nigeria and surrounding countries. Figure 2 shows the estimated poultry population growth for Nigeria and surrounding countries in West Africa between 2006 and 2013.

Previous outbreaks (January 2006 to July 2008)

The previous HPAI H5N1 epidemic (2006–2008) in Nigeria was confirmed in February 2006, in commercial poultry in Kaduna State and resulted in 9.8 percent (76 of 775) LGAs affected in 25 states by 2008. During the first three months of the epidemic (February to April 2006), 13 states were affected, with LGAs in the states of Kaduna (3 of 23 LGAs), Katsina (4 of 34 LGAs) and Kano (4 of 44 LGAs) the most affected, demonstrating a smaller spatial distribution of the disease than that observed in the current outbreak.

In addition to the outbreaks in Nigeria, the disease was reported in seven other African countries within one to three months of the incursion into Nigeria, affecting Cameroon, Egypt and the Niger in February 2006, Burkina Faso, the Republic of Côte d'Ivoire and the Sudan in April 2006 and Djibouti in May 2006. Ten months later in December 2006 the disease was reported in Benin. Of all the countries affected, Egypt is the only country where the disease is now considered endemic for H5N1 HPAI, despite continuous efforts to control the disease.

Identification of the virus involved in the previous outbreaks in Nigeria by molecular techniques (genotyping) suggested at least three independently introduced lineages (of an Asian lineage origin) in the country. More extensive analyses of these virus isolates showed that the African HPAI (H5N1) strains involved in the affected countries formed three clusters: (a) Cluster A contains the strains found in a southwestern Nigerian farm and includes all strains found in the Niger; (b) Cluster B includes the strains from a southwestern Nigerian farm and includes all Egyptian strains; and (c) Cluster C contains strains found in Burkina Faso, northern Nigeria, the Republic of Côte d'Ivoire and the Sudan.

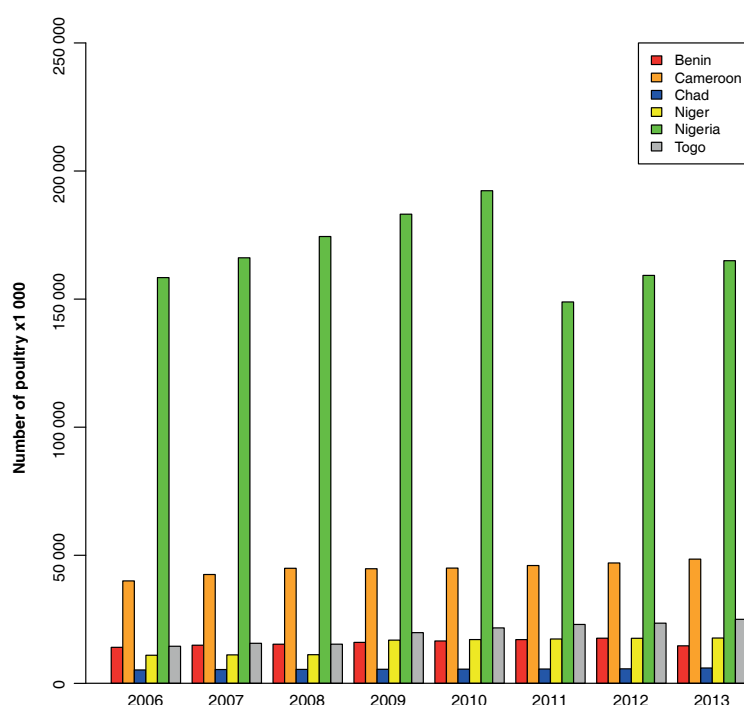
Compared to previous outbreaks, the current events in Nigeria appear to be more widespread with the disease spreading quickly to many states and geographical areas. This pattern of spread may be associated with, but not limited to, uncontrolled movement of poultry and

Table 1. Estimates of chicken populations for Nigeria and surrounding countries for 2013.

Country	Chickens (x 1 000 heads)
Benin	14 661
Cameroon	48 500
Chad	6 000
Niger	17 700
Nigeria	165 000
Togo	25 000
Grand total	820 286

Source: FAOSTAT, 2013.

Figure 2. Growth in poultry numbers for select countries in West Africa between 2006 and 2013.



Source: FAOSTAT, 2014.

poultry products, and the lack of an effective contingency plan to guide the containment of the first outbreaks reported in January 2015. Although there is no clear estimation of the socio-economic impact, the current outbreaks in Nigeria have so far resulted in approximately one million birds being destroyed from 255 farms, in 18 states. This destruction implies a direct impact on food security and the livelihoods of small poultry holders because of the costs of the disease, restrictions on animal movement and the closing of LBMs.

H5N1 HPAI was detected in large- and medium-scale poultry farms on 10 February 2015 for the first time in Sanguié Province, West Centre Region and in March 2015 in Kadiogo Province, Centre Region. As of 1 April 2015 a total of 115 000 poultry died in the country. The last reported outbreaks in Burkina Faso occurred in March and May of 2006.

On 3 April 2015, the Niger has reported a suspected outbreak of H5N1 HPAI on a chicken farm in the southern town of Maradi, near the border with the Nigeria which has confirmed cases of the virus in several northern states; more than half of the 2 440 chickens on the farm have died. The suspected cases in the Niger came a week after neighbouring Burkina Faso also confirmed an outbreak of H5N1. The last reported case in the Niger was in May 2006, always in the Maradi Region.

Risk factors and implications for further spread

Wild birds

The role of wild birds in the introduction of H5N1 HPAI to new areas is not well understood, but cannot be ruled out in this current situation. Tian *et al.* (2015) recently demonstrated that migratory birds contribute to the seasonal occurrence of H5N1 epidemics locally as well as along flyways, but the risk of intercontinental spread of the virus between flyways is considered to be low. Nigeria represents a critical wintering area for many long-distance migratory birds between Europe and Africa along the western Siberian-Mediterranean-West Africa flyway, particularly for some Palaearctic duck species, several species of shorebirds and some birds of prey. There are several wetlands for migratory and resident waterfowl located across Nigeria. In the northeast, are the Hadejia-Nguru wetlands and Lake Chad, and in the south, the Niger delta (Figure 3). The Hadejia-Nguru wetlands are located about 25 kilometres from the first H5N1 outbreaks reported in Kano State in January 2015 and represent a suitable habitat for the H5N1 virus (Checchi *et al.*, 2008). The main wild bird species that migrate to northern Nigeria, are the northern pintails (*Anas acuta*), garganeys (*Anas querquedula*), white-faced whistling duck (*Dendrocygna viduata*), tufted

duck (*Aythya fuligula*), common pochard (*Aythya ferina*), common teal (*Anas crecca*), grey heron (*Ardea cinerea*) and Northern Shoveler (*Anas clypeata*). Figure 3 (b and c) shows critical waterfowl wintering sites in Western Africa, and wetlands distribution in northern Nigeria, particularly in Kano State.

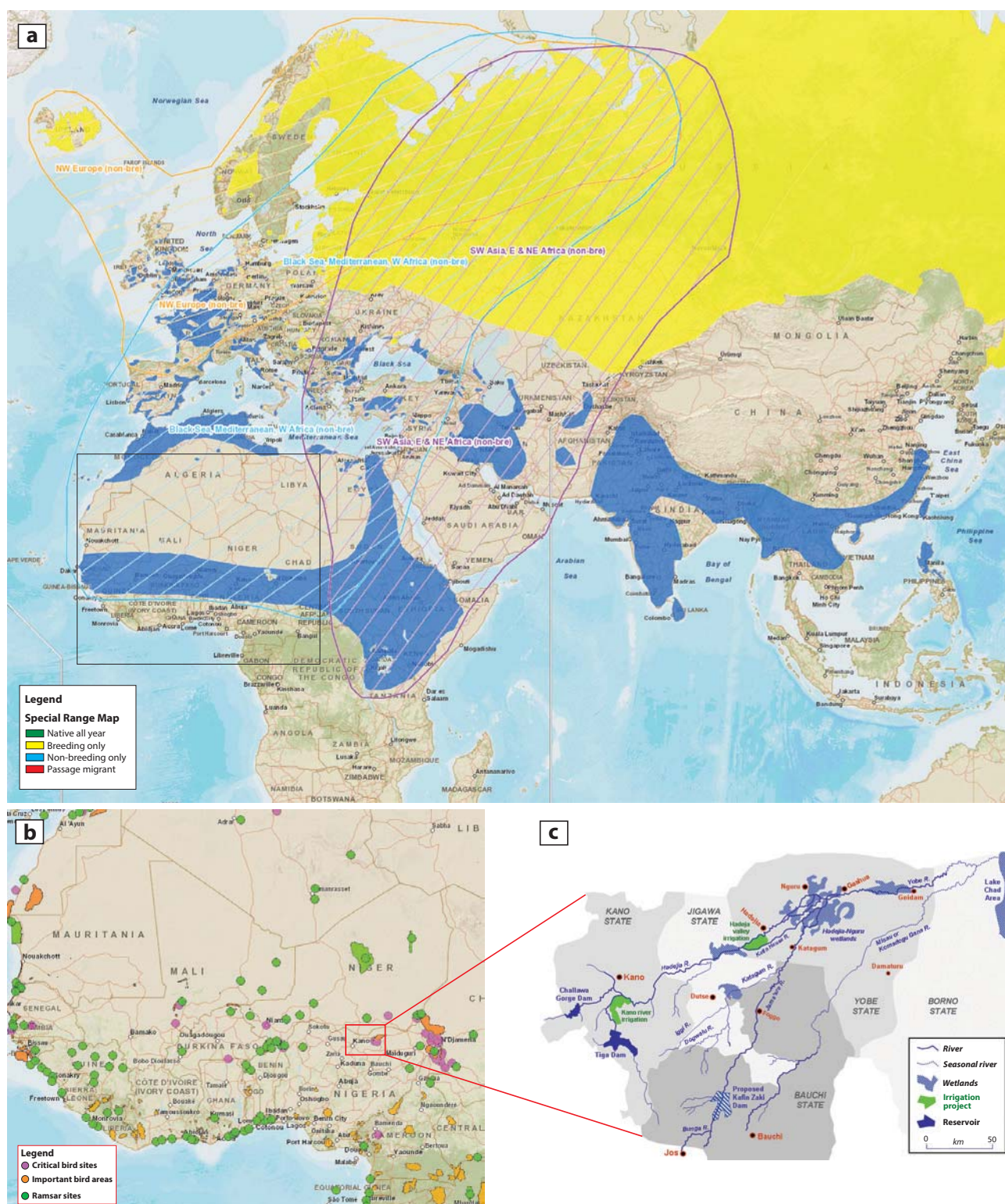
Wetlands cover almost 7 percent of the total country and are a crucial resource for local communities, providing drinking water as well as water for crop irrigation and forage for livestock. They are also a major source of fish, supplying approximately 6 percent of Nigeria's inland fish catch. In total, about 1.5 million farmers, herders and fishermen in Nigeria depend on the wetlands for their income and subsistence. In Nigeria, poultry manure is commonly used for fish pond fertilization (Musa *et al.*, 2012). Contaminated and untreated poultry manure in organic fertilization of fish ponds represent a potential source of infection and spread of avian influenza viruses in the aquatic habitats. Considering these poultry practices and the increased interface between farmers, domestic and wild birds in the wetlands, northern Nigeria is considered to be at high risk of H5N1 spread.

West Africa has numerous waterfowl sites (Figure 3). Although, trade appears to be the primary source of transmission and spread of the H5N1 virus in Nigeria, spread is also possible through the movement of infected wild birds between wetlands in Nigeria and neighbouring countries (Figure 3b). Captive wild birds are normally kept in a village environment before being sold in LBMs and, thus, they may enter into contact with poultry.

Poultry trade

Poultry and poultry-related movement in the region surrounding Nigeria is not well understood, but formal trade data show that most countries in the region import varying quantities of live birds (including day-old chicks), eggs and poultry meat from many countries within and outside the West Africa region. Formal regional trade in live birds exists between Nigeria and Burkina Faso, the Niger and the Republic of Côte d'Ivoire. Poultry eggs move from Togo to the Niger, while poultry meat moves between Nigeria and Benin. Eggs are also moved between the Niger and Togo, and between the Niger and Benin (see Figure 4). Nigeria applies an import prohibition list that includes frozen poultry and bird eggs. However, it is assumed that an informal movement of poultry and eggs exists between bordering countries, which is influenced by price and market opportunities. In addition to formal trade, there is evidence of informal cross-border trade between Nigeria and neighbouring countries, mainly through the smuggling of such things as frozen poultry products.

Figure 3. (a) Northern pintail (*Anas acuta*) range map within the Black Sea-Mediterranean-Western Africa flyway (cyan line) and the Southwestern Asia and Northeastern Africa flyway (pink line); (b) Critical waterfowl wintering sites in Western Africa; (c) Wetlands in Northern Nigeria, Kano State.



Sources: Maps (a) and (b) downloaded from "The Critical Site Network Tool" website; map (c) from Wikipedia.²

¹ Available at: dev.unep-wcmc.org/csn/default.html#state=species&SpcRecID=457

² Available at: http://en.wikipedia.org/wiki/Hadejia-Nguru_wetlands

International sources of poultry and related products for Nigeria and the region are also varied and include several countries in Europe as well as Asian countries like China where H5N1 HPAI is currently circulating. FAOSTAT data show that between 2000 and 2010,

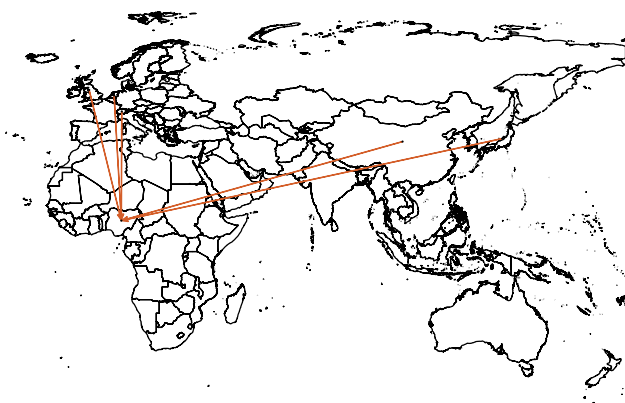
Nigeria imported 23 000 chickens, 27 tonnes of chicken meat, 4 tonnes of duck meat and 3 tonnes of dried eggs from China.

Poultry or poultry product movement within Nigeria is complex, with patterns and directions primarily influenced by the

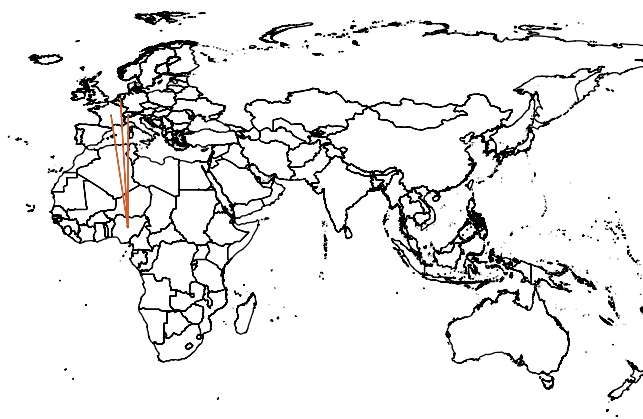
geographic distribution of the various types of poultry production systems, marketing practices and the seasonality of demand. According to records for 2008, poultry farms of "indigenous" chicken and guinea fowl are concentrated in the north.

Figure 4. Map showing the direction of trade of poultry and related products 2008–2010. Adapted from Akinwumi, 2010.

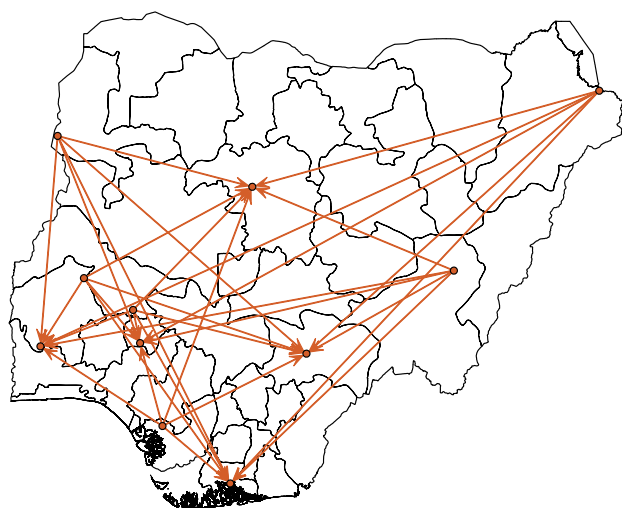
(a) Chicken imports



(b) Duck imports



(c) Local day-old chick movement



(d) Regional guinea fowl movement



(e) Local guinea fowl egg movement



(f) Commercial indigenous poultry movement



Grandparent stock, commonly sourced from Europe (prior to government-regulated importation bans on poultry), and day-old chick producers are located mainly in the southwest. Egg farms are distributed all over Nigeria, but are concentrated around major urban centres. Broiler farms, scattered across the country, form an important part of the backyard poultry sector. The poultry industry uses Nigeria's extensive road network to transport poultry, providing the opportunity for disease to spread rapidly and widely across the country. See Figure 4 for poultry-related movement in Nigeria.

As a result, the pattern of movement of poultry products (i.e. frozen chicken) in Nigeria is from the southwest to the north via the Federal Capital Territory, while live poultry (including chicken and guinea fowl) are moved from the north to the south, especially the southwest. This pattern implies significant risk of spread of HPAI H5N1 from north to south, compared to the reverse. In addition, the marketing of live birds from the rural sector via LBMs, and the common practice of agents assembling large numbers of chickens from multiple markets in trucks for further sale to southern cities and towns, potentially increase the risk of further spread to yet unaffected areas.

From the pattern observed during this current epidemic, infected farms were first identified in Kano State in the north, followed by a long distance jump to the southwest

and then by short distance spread across the north and south simultaneously.

The movement of people

In addition to trade-related poultry movement, transhumance or translocation may be another route through which HPAI H5N1 spreads since such movement is common in the region. Transhumance is known to occur seasonally from Togo and Sahelian countries to Nigeria, but it is unlikely that transhumance involves movement of poultry. However, anecdotal evidence suggests that when people migrate they do so with their poultry. Additionally, the movement of people and equipment from affected countries in Southeast Asia to Nigeria does occur, but the risk of virus spread along this route cannot be estimated.

Factors influencing the movement of poultry

Factors that influence poultry-related movement in Nigeria and bordering countries include differentials on the price of birds, the movement of people as they flee political or civil unrest, and religious celebrations, among others. Currently, there are several areas in Nigeria under active conflict, including areas in the north, where the capacities of veterinary authorities to implement preventive and control measures will likely be limited.

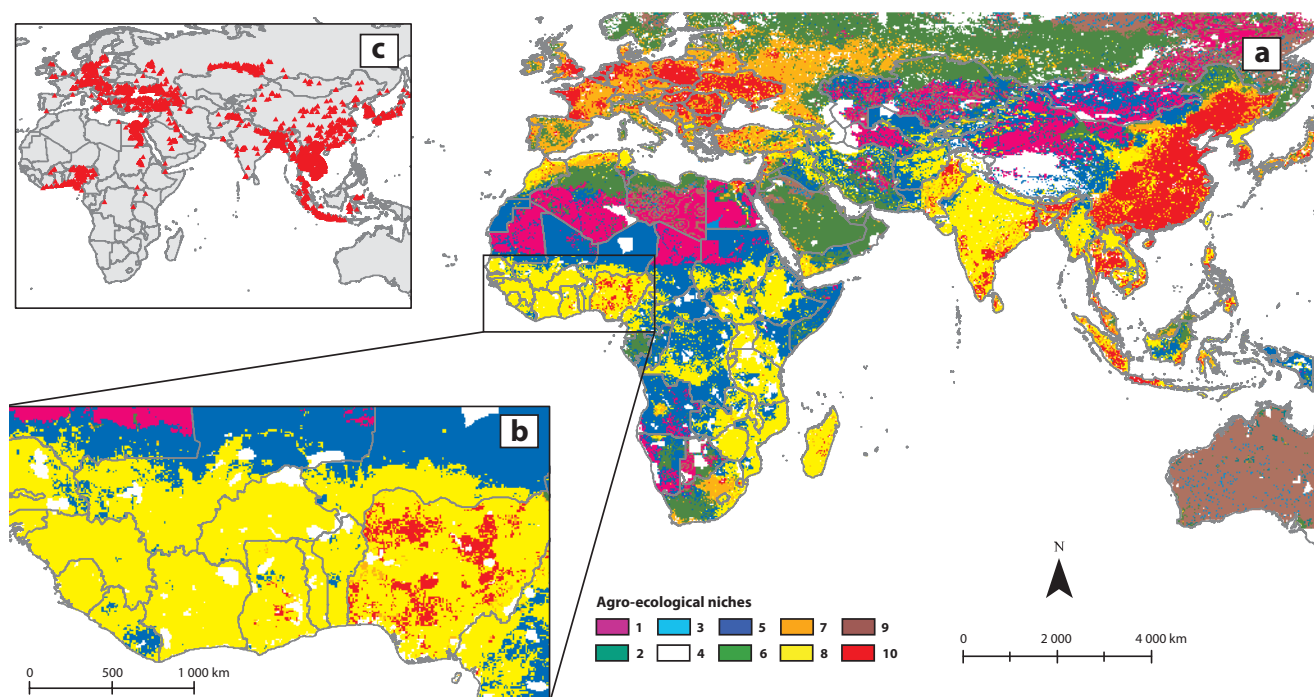
In these areas, the uncontrolled movement of local communities is likely associated with increased risk of virus spread. General elections in Nigeria will be held in March 2015. There may be an increased risk of virus spread across the country through the increased movement of people (with poultry) returning to their home constituencies to vote.

H5N1 spread and persistence risk based on agro-ecological niches

A global-level analysis of HPAI H5N1 risk factors to identify and map areas with similar agro-ecological profiles in relation to HPAI risk of spread and persistence which was conducted by Hogerwerf *et al.*, 2010, and updated by the Food and Agriculture Organization of the United Nations (FAO), resulted in ten agro-ecological clusters or niches made up of the six factors considered as the main H5N1 drivers in Southeast Asia. These risk factors included backyard and commercial chicken densities, duck density, human population density, gross domestic product (GDP) per capita and proximity to wetlands (as a proxy for water bird risk areas; see Figure 5).

Nigeria was characterized by niches 8 (yellow) and 10 (red), covering 74 percent and 19 percent of its land area, respectively (Figure 5b). The other West African countries were characterized by niche 8. The yellow

Figure 5. (a) A ten-cluster niche map obtained using k-mean clustering. (b) The agro-ecological niches in western Africa. (c) H5N1 outbreaks between 2004 and 2015. The red and yellow niches included regions with the largest numbers of H5N1 outbreaks.



niche has high densities of backyard chickens and human population, while the red niche has high densities of commercial chickens and ducks. Both niches were characterized by locations at moderate distances from wetlands (about 30 km). The highest number of H5N1 outbreaks in Nigeria during 2015 was observed within niche 8.

The agro-ecological patterns in Nigeria are similar to those observed in Southeast Asian countries, such as Cambodia, Indonesia and Viet Nam where HPAI H5N1 routinely occurs. Ghana is the only country in West Africa showing an agro-ecological pattern relatively similar to that observed in Nigeria, implying similar HPAI H5N1 risks. These results highlight similar HPAI H5N1 risk for Nigeria and countries in Southeast Asia based on similarities in the agro-ecological patterns observed in these countries. Given the wide distribution of the yellow niche in western Africa, the risk of disease spread in the region is considered to be relatively high.

H5N1 HPAI risk management

Nigeria

The Government of Nigeria has responded to the current HPAI H5N1 outbreak through poultry movement controls and the closing of

LBM, the culling of infected premises and the payment of compensation. Effort has also been made to impose movement controls to reduce spread to unaffected areas, and within infected areas. Communication with stakeholders focused on raising awareness of actions that can reduce the risk of HPAI H5N1.

Vaccination against H5N1 HPAI has not been implemented. Egypt is the only country in the region considered endemic for H5N1 HPAI, and it is implementing routine vaccination. Countries in the immediate neighbourhood of Nigeria are, thus, at risk and most will need to prepare by updating surveillance and contingency plans, and mobilizing emergency funding to support immediate preparedness efforts.

FAO is assisting Nigeria to contain the current epidemic and to reduce the risk of spread of H5N1 HPAI from Nigeria to surrounding countries.

Control and prevention measures for HPAI H5N1, like any other transboundary animal disease (TAD), include: enhancing surveillance activities (passive, active and risk-based), animal movement control, vaccination, quarantine, humane culling and adequate compensation.

At-risk countries

Countries at risk in West Africa such as Benin, Cameroon and Togo need to:

- maintain good communication with veterinary authorities of Nigeria to follow the evolving HPAI H5N1 situation;
- review and revise good emergency practices and contingency plans for animal disease, including compensation (see *FAO manual*, 2002);
- enhance surveillance and raise awareness among stakeholders about the disease and its clinical signs in animals, to ensure early detection;
- implement or increase inspection of susceptible animals at gathering places such as live animal markets;
- enhance the laboratory capacities for rapid detection of any potential case of H5N1 HPAI;
- ensure timely submission of positive samples to international reference laboratories for virus characterization.

In both affected and at-risk countries, wildlife authorities should investigate unusual morbidity or mortality in wild bird species in areas where poultry and wild bird interface exists.

FAO encourages countries and poultry farmers to report any suspicion of poultry disease compatible with avian influenza. FAO offers technical assistance to countries to have biological samples shipped for diagnostic testing to FAO reference centres or OIE reference laboratories.

Contact empres-shipping-service@fao.org for information prior to sample shipment



and note that sending samples out of a country requires an export permit from the Chief Veterinary's Office of the country and an import permit from the receiving country.

Conclusions (and looking ahead)

The reoccurrence of H5N1 HPAI in Nigeria confirms the constant risk posed by this virus.

The poultry in Nigeria and in bordering countries are highly susceptible to HPAI H5N1. All countries are officially free of this disease. It is expected that HPAI H5N1 will spread widely within Nigeria and may affect a high proportion of poultry until effective biosecurity measures are imposed. Continued circulation (i.e. persistence) within the Nigerian poultry population is possible, but given previous experience with the disease during 2006–2008, this may be unlikely. The veterinary services of Nigeria have shown their ability to eliminate HPAI H5N1 during the first outbreaks of the disease in 2006–2008 and this could be replicated if resources are available to implement control measures. Affected areas located in conflict zones such as Kaduna State, where the actions of veterinary services are limited, may result in continued spread. Currently, the outbreak continues to spread and patterns are distinct from that of the previous epidemic. The current epidemic has spread faster and wider geographically than the previous epidemic (data not shown). Based on this evidence, the risk of the virus spreading throughout Nigeria is high.

The risk of spread to bordering countries will depend on quarantine controls at land borders with Nigeria that target the various routes through which infection could spread,

including the movement of live birds, people or fomites. Establishment in bordering countries will also depend on the ability of the countries' surveillance systems to detect and respond to new incursions rapidly, if they do occur. During the previous HPAI H5N1 incursion, almost all countries affected in the region were able to eliminate the disease with international support coordinated by FAO. However, regular training of veterinary services staff in the region in disease recognition, investigation and response is needed.

The outbreaks in Nigeria are currently concentrated in areas bordering the Niger in the north, and Benin in the southwest. Movement of poultry from northern areas of Nigeria to be sold in the southern areas of the Niger has been known to occur. Movement of people from southwestern Nigeria to Togo through transhumance is also likely. Given their proximity to Nigeria (through sharing of the border) and commercial trading links, the following countries are at immediate risk of disease spread: Benin, Cameroon, Chad and the Niger. These countries have important poultry industries and the potential consequences of HPAI H5N1 outbreaks there would be significant. Other countries that had reported outbreaks in the past are also at risk. These include Burkina Faso, Djibouti, the Republic of Côte d'Ivoire and the Sudan.

FAO stands ready to provide assistance to member countries in West Africa to prevent the introduction of H5N1 HPAI, to reduce the risk of disease spread and to safeguard vulnerable, livestock-related livelihoods.

FAO assistance should be focused on improving capacities of animal health systems for i) rapid detection and disease early warning; ii) laboratory capacity building; iii) risk management; iv) surveillance; and v) prevention and control.

Countries at risk in West Africa are recommended to:

- review and assess their level of preparedness for possible incursions of HPAI, including their country's contingency plan for H5N1 HPAI and levels of surveillance;
- conduct proper field disease investigation procedures and the measures required to manage the risks for poultry and human populations, including biosecurity;
- review and assess the diagnostic capabilities relative to the specific requirements for laboratory analysis of H5N1 HPAI, including laboratory procedures, appropriate equipment and supplies;
- review and assess communication and awareness strategies;
- review coordination mechanisms between in-country, regional stakeholders, including compensation strategies;
- evaluate technical capacity development needs, utilizing current knowledge and previous assessments;
- consider the means of identifying and addressing resource needs for enhanced avian influenza prevention and control programmes.

At-risk countries would benefit from knowledge and information sharing by relevant countries in the region.

FAO provides and assists countries with technical capacity to respond to emergencies. It also has a role in facilitating information exchange and collaboration between Nigeria and other countries at risk in West Africa.

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CONTACT

The Emergency Prevention System (EMPRES) is an FAO programme, founded in 1994, with the goal of enhancing world food security, fighting transboundary animal and plant pests and diseases and reducing the adverse impact of food safety threats. EMPRES-Animal Health is the component dealing with the prevention and control of transboundary animal diseases (TADs).

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EMPRES-Animal Health can assist countries in the shipment of samples for TAD diagnostic testing at a FAO reference laboratory and reference centre. Please contact **Empres-Shipping-Service@fao.org** for information prior to sampling or shipment. Please note that sending samples out of a country requires an export permit from the Chief Veterinarian's Office of the country and an import permit from the receiving country.



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