

CRS Report for Congress

Avian Influenza in Poultry and Wild Birds

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Summary

Avian influenza is a viral disease that primarily infects birds, both domestic and wild. Certain strains of bird flu break the avian barrier and have been known to infect other animals and humans. Avian flu viruses are common among wild bird populations, which act as a reservoir for the disease. While rarely fatal in wild birds, avian flu is highly contagious and often fatal in domestic poultry, prompting strict biosecurity measures on farms. International trade restrictions imposed by countries to counter avian flu can have large economic effects.

The H5N1 strain of highly pathogenic avian influenza (HPAI) has spread throughout Asia since 2003, infecting mostly poultry, some wild birds, and a limited number of humans through close domestic poultry-to-human contact. The virus has spread beyond Asia, reaching Europe in 2005 and the Middle East and Africa in 2006. Over 250 million poultry have died or been destroyed internationally. Human mortality among the more than 275 people infected exceeds 55%. Fears that the virus could mutate to allow efficient human-to-human transmission and cause a human pandemic have prompted a massive political and public health response.

Since wild birds can carry the highly pathogenic H5N1 virus, federal, state, and other agencies have increased surveillance of wild and migratory birds. Surveillance is particularly high in Alaska, where Asian and American flyways overlap. Migrating birds from Asia could carry the virus to Alaska and infect birds from the Americas on shared nesting grounds. The newly infected birds could carry the virus down North American flyways. Alternatively, imports into Central and South America could introduce the virus to the Western Hemisphere, and subsequent wild bird migration could bring the virus north into the United States. The United States also has blocked imports of poultry and poultry products from H5N1-infected countries.

The highly pathogenic H5N1 strain has not yet been detected in the United States. But surveillance has detected different, low pathogenicity strains in wild bird populations, including a low pathogenicity H5N1. The low pathogenicity strain does not pose the same threat as highly pathogenic H5N1. Even if highly pathogenic H5N1 is found in the Americas, it does not signal the onset of a global human pandemic. The virus apparently has not yet mutated to allow efficient human-to-human transmission, and scientists disagree whether or when this may happen.

Controlling avian flu in poultry, and to the extent possible in wild birds, is seen as the best way to prevent a human pandemic from developing — by reducing the number of animal hosts in which the virus may evolve. Indemnity payments to compensate farmers for birds destroyed in eradication efforts are seen as an important element of increasing success to control the disease.

Congressional agriculture committees have held hearings on avian influenza preparedness, and appropriators have increased funding for surveillance and other preparedness activities for poultry and wild birds.

This report will be updated periodically.

Contents

What Is Avian Influenza?	1
Status of Avian Influenza Outbreaks	2
Status in the United States	2
Status in the Rest of the World	3
Transmission	4
Transmission In Wild Birds	4
Transmission In Poultry	5
Transmission Across International Borders	5
Human Infection	6
Food Safety	7
Control	7
International Control Efforts	7
Preventing Infection	8
Vaccines	9
Eradicating Outbreaks	9
Compensation for Farmers	10
Economic Impacts	10
Legislative Actions	12
Congressional Hearings	12
Federal Appropriations to Control Avian Flu	13
Poultry	13
Wild Birds	13

List of Figures

Figure 1. Migratory Bird Flyways of the World	2
Figure 2. Geographic Concentration of Broiler Production	12

Avian Influenza in Poultry and Wild Birds

What Is Avian Influenza?

Avian influenza (AI) viruses exist throughout the world in many different strains. Avian flu is an Influenza A virus that infects both wild and domestic birds, and certain strains have been known to infect both animals and humans. This report discusses avian flu broadly as it affects agriculture and wild birds, especially with reference to highly pathogenic H5N1 avian flu.

Avian flu assumes two forms in birds:

- a low pathogenicity (LPAI) form that causes mild illness, and
- a highly pathogenic (HPAI) form that is extremely contagious, causes severe illness, and frequently has high rates of mortality.

Pathogenicity is determined using two methods: genetic sequencing, and inoculating healthy chicks and monitoring their mortality. Mortality under highly pathogenic avian flu ranges from 30%-100%, and is usually less than 20% for low pathogenicity.

Both forms are possible in many strains, designated by the letters H and N. The strain designations refer to surface proteins on the virus called hemagglutinin (H) and neuraminidase (N). Each AI virus has one hemagglutinin and one neuraminidase protein. Sixteen H subtypes and nine N subtypes have been identified, and are designated by numbers. They can occur in any combination, resulting in 144 possible strains (for example, H1N1, H7N2, etc.).

Most strains are low pathogenicity, but some strains (particularly H5 and H7) can mutate from LPAI into HPAI during the course of an outbreak. Globally during the past 20 years, H5 or H7 LPAI viruses have mutated into HPAI on five occasions. Thus, low pathogenicity outbreaks in domestic poultry are treated aggressively.

Low pathogenicity outbreaks in poultry are not uncommon, since LPAI is entrenched in wild birds. The most recent cases in U.S. poultry occurred in 2004, with low pathogenicity strains of H7N2 in Delaware, Maryland, and New Jersey; and low pathogenicity H2N2 in Pennsylvania. Separately, an H5N2 strain was found in Texas in 2004 and was classified genetically as highly pathogenic, although it did not manifest as such in terms of mortality. Other recent cases include low pathogenicity outbreaks of H7N2 in the Northeast in 2003, and in the mid-Atlantic in 2002. Only three highly pathogenic outbreaks have occurred in the United States in the past century (1924, 1983, and 2004).

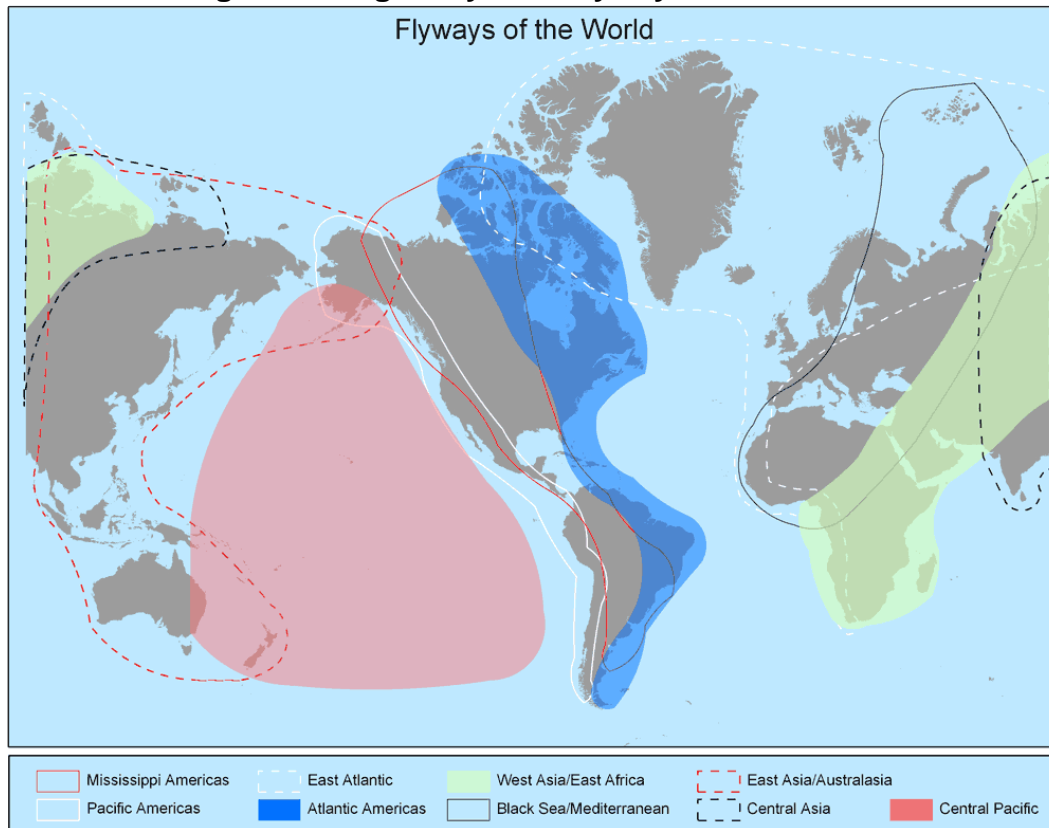
Status of Avian Influenza Outbreaks

A strain of highly pathogenic avian influenza (H5N1) has spread throughout Asia since 2003, and has subsequently moved into Europe, the Middle East, and Africa. It has infected mostly poultry and wild birds, but a limited number of humans have contracted the disease through close domestic poultry-to-human contact. Over 250 million poultry have died or been destroyed internationally.

Status in the United States¹

Currently, there are no outbreaks of any avian flu virus in domestic poultry in the United States. Moreover, the highly pathogenic H5N1 strain of current global concern has not reached North America in wild birds, poultry, or humans.

Figure 1. Migratory Bird Flyways of the World



Source: U.S. Geological Survey, [http://alaska.usgs.gov/science/biology/avian_influenza/flyways.html]. Shaded areas give only a general impression of migration routes: storms, high winds, and random variations can send any bird off the routes shown here. Available in a color version of this report on the CRS website at [<http://www.crs.gov>].

Since wild birds can carry the highly pathogenic H5N1 virus, the U.S. Department of Agriculture (USDA) and the Department of the Interior (DOI) have increased surveillance of wild and migratory birds. Examining migration routes shows how the disease could spread from Asia into North America (**Figure 1**).

¹ See U.S. Dept. of Agriculture (USDA) at [<http://www.usda.gov/birdflu>], and the Centers for Disease Control and Prevention (CDC) at [<http://www.cdc.gov/flu/avian>].

Surveillance is particularly high in Alaska, where Asian and American flyways overlap. Migrating birds from Asia could carry the virus to Alaska, and infect birds from the Americas on shared nesting grounds. The newly infected birds could carry the virus down North American flyways. This was particularly a concern through the summer and fall of 2006, but the possibility may return later in 2007, since highly pathogenic H5N1 continues to circulate in Asia.

Since April 2006, over 107,000 samples have been collected from wild birds.² About 19% of those samples are from Alaska, with the remainder spread throughout the lower 48 States. While no instance of highly pathogenic H5N1 has been found to date in North America, the tests have detected other low pathogenicity strains of avian influenza.³ For example, in August 2006, two wild mute swans in Michigan were confirmed positive for a low pathogenicity strain of H5N1. The swans showed no signs of sickness. This LPAI strain does not threaten poultry or humans like highly pathogenic H5N1, is not in commercial flocks, and was already known to exist in North America.

Preliminary testing of birds can show positive results for H5N1 for three different reasons. First, if a bird is infected with two different strains of avian influenza, one with H5, and another with N1, the test may be positive. Birds initially testing positive for the presence of both proteins require further testing to determine if the H5N1 viral type itself is present. Second, some forms of H5N1 are low pathogenicity and are already somewhat common in North American wild bird populations. The low pathogenicity H5N1 strain (sometimes called “North American” H5N1) is not a human health problem like the highly pathogenic Asian strain of H5N1. Hunters who might eat infected birds, and hunting dogs that might retrieve them, are at no known risk from low pathogenicity H5N1. All the H5N1 virus found to date in the United States and Canada has been LPAI. The third possibility — an H5N1 that is also highly pathogenic (the strain of concern in the worldwide outbreak) — has not yet been reported in the Americas.

Status in the Rest of the World⁴

The first official report of H5N1 in humans was a 1997 outbreak in Hong Kong, with transmission from domestic poultry to humans. This outbreak was contained

² A description of the overall surveillance plan and data is available from the National Biological Information Infrastructure, “Highly Pathogenic Avian Influenza Early Detection Data System (HEDDS),” at [<http://wildlifedisease.nbio.gov/ai/index.jsp>]. USDA’s Office of Inspector General identified gaps in the response and surveillance plan. USDA-OIG, *Animal and Plant Health Inspection Service Oversight of Avian Influenza*, Audit Report 33099-11-Hy (June 2006), at [<http://www.usda.gov/oig/webdocs/33099-11-HY.pdf>]. Steps have been taken subsequently to improve surveillance.

³ U.S. Dept. of Agriculture and U.S. Dept. of the Interior, “Low Pathogenic ‘North American’ H5N1 Avian Influenza Strain in Wild Birds: Presumptive and Confirmed Test Results,” at [<http://wildlifedisease.nbio.gov/ai/LPAI-Table.jsp>].

⁴ For discussion of international issues and avian influenza, see the World Health Organization (WHO) at [<http://www.who.int/en>], U.N. Food and Agriculture Organization (FAO) at [<http://www.fao.org>], and the World Organization for Animal Health (OIE) at [<http://www.oie.int>].

by an aggressive program to slaughter exposed poultry (“stamping out”). But the virus re-emerged several years later.

Since December 2003, at least 10 Asian countries have had confirmed outbreaks of highly pathogenic H5N1 in poultry. The first generally recognized outbreak of the H5N1 strain in wild birds occurred among waterfowl at the Qinghai Lake Nature Reserve in west-central China in 2005. In 2005, the virus spread westward toward eastern Europe, being confirmed in six new countries. In 2006, it spread to dozens of new countries in Europe, the Middle East, and Africa. The virus has appeared in 56 countries on every continent of the eastern hemisphere, except Australia.⁵

The H5N1 outbreak in poultry and birds has grown in scale, causing massive international government responses, and economic, food, and trade impacts due to the animal disease and public health concerns. The U.N. Food and Agriculture Organization (FAO) estimates that over 250 million poultry have died or been culled internationally. Some countries were reluctant to acknowledge the disease for fear of economic consequences. In other countries, the lack of compensation for farmers whose flocks are destroyed has been a disincentive to report outbreaks early.

Transmission

Transmission In Wild Birds

Wild birds are the primary natural reservoir for Influenza A viruses. Transmission of the disease among wild birds is through fecal material and appears most commonly among waterfowl (ducks, geese, and their relatives), shorebirds (plovers, sandpipers, and their relatives), gulls, and terns. In wild populations, avian flu is not typically fatal — or even apparent. However, an outbreak of the H5N1 strain is known to have appeared in Qinghai province in China in May 2005. Most of the wild species at greatest risk are highly migratory, e.g., ranging from Siberia to southern Asia, or Norway to central Africa. Many nest in dense aggregations during the breeding season (e.g., many species of terns and gulls), or winter in dense flocks (e.g., many species of gulls, geese, and ducks), or form huge flocks for migration or at migratory stop-over sites (e.g., many species of plovers, sandpipers, and their relatives). Crowded conditions such as these tend to facilitate transmission of a disease.

⁵ World Organization for Animal Health (OIE), “Update on Avian Influenza in Animals,” March 8, 2007, at [http://www.oie.int/download/avian%20influenza/a_ai-asia.htm]. Countries reporting highly pathogenic H5N1 in wild birds or poultry at some time since 2003 include Afghanistan, Albania, Austria, Azerbaijan, Bosnia and Herzegovina, Bulgaria, Burkina Faso, Cambodia, Cameroon, China, Côte d’Ivoire, Croatia, Czech Republic, Denmark, Djibouti, Egypt, France, Georgia, Germany, Greece, Hong Kong, Hungary, India, Indonesia, Iraq, Iran, Israel, Italy, Japan, Jordan, Kazakhstan, Kuwait, Laos, Malaysia, Mongolia, Myanmar, Niger, Nigeria, Palestine, Pakistan, Poland, Republic of Korea, Romania, Russia, Serbia and Montenegro, Slovakia, Slovenia, Spain, Sudan, Sweden, Switzerland, Thailand, Turkey, Ukraine, United Kingdom, and Vietnam.

While avian influenza is rarely fatal in wild birds, some scientists fear that an outbreak of HPAI could be particularly harmful to populations of birds already under threat from habitat loss or excessive harvests.

Transmission In Poultry

Domesticated poultry flocks can be infected by contact with wild birds and their excretions. Avian flu is highly contagious in poultry, and more so in crowded conditions. The virus is spread by contact with infected feces, nasal, or eye excretions. The incubation period for avian flu may last as long as 10 days, and the virus may be shed from live poultry for up to 21 days. Confined poultry sheds used in commercial production prevent contact with wild birds and thus reduce a source of infection, but may magnify the economic impact if the virus is introduced. People, clothing, vehicles, and supplies can carry the virus between farms. Thus, strict biosecurity measures are adopted by nearly all U.S. commercial poultry farms, not only to prevent the spread of avian flu, but also to shield the flocks from other infections.⁶

Avian flu viruses have been common in live bird markets (also known as *wet markets*). These markets sell less than 1% of U.S. poultry, but outbreaks concern commercial growers, who practice tighter biosecurity than backyard growers or live bird markets. USDA has focused on these markets because insufficient biosecurity allowed birds and equipment to intermingle at the market and return to farms. Examples of states with live bird markets include New York, New Jersey, and Texas. In Asia, a larger network of live bird markets and backyard farms has made eradication difficult.

Transportation of roosters for cock fighting, which is illegal in the United States (except in Louisiana and New Mexico) and some other parts of the world, is also a suspected route of disease transmission.

Transmission Across International Borders

Pathogens may spread across international borders in several ways:

- *naturally* (e.g., wild bird migration, wind),
- *accidentally* (e.g., in legal or smuggled shipments of animals or products that happen to be infected), and
- *intentionally* (e.g., legally for controlled use in science, or illegally for crime or terrorism).

The ability of H5N1 to spread naturally via migratory birds has been discussed above, and such migration cannot be stopped at international political borders. Surveillance programs are designed to detect the pathogen once it crosses a border, and enable a more rapid response than without surveillance.

⁶ For biosecurity recommendations, see the USDA “Biosecurity for the Birds” website at [<http://www.aphis.usda.gov/vs/birdbiosecurity/hpai.html>].

To reduce the possibility that highly pathogenic H5N1 enters the United States accidentally or intentionally, the USDA has blocked imports of poultry and poultry products (such as feathers, meat, or eggs) from affected countries, and increased smuggling interdiction efforts. Highly pathogenic avian influenza viruses are considered a *select agent* under bioterrorism rules (9 C.F.R. § 121.3), and are subject to restrictions for their possession, use, and transportation.⁷ The USDA Animal and Plant Health Inspection Service (APHIS) determines the scope of import restrictions regarding live animals and animal products, and issues import and other health regulations. APHIS employs smuggling interdiction units and staff at pre-inspection stations internationally to enforce import restrictions. Moreover, the domestic border inspectors of Department of Homeland Security (DHS) Customs and Border Protection check passengers, cargo, and conveyances (vehicles, ships, and planes) at ports of entry for prohibited items. DHS inspectors include a cadre of agricultural specialists, many of whom were formerly employed by APHIS prior to the transfer of agricultural border inspectors to DHS in 2003.

Despite the attention given to migratory bird surveillance in North America, some believe that poultry imports into Central and South America are a more likely pathway for the virus to enter the Western Hemisphere.⁸ If the virus spreads from poultry to wild birds, subsequent wild bird migration could bring the virus north into the United States. Officials may have time to redeploy wild bird surveillance to focus on this possible pathway.

Human Infection⁹

Certain avian flu strains, including H5N1, can infect humans through close poultry-to-human contact, usually through contact with fecal matter or other live bird excretions in backyard settings or home slaughtering. Human infection has not appeared to result from contact with wild birds.

While the species barrier is significant, effects have been severe when infection occurs. H5N1 infection in humans may produce rapid deterioration leading to viral pneumonia and organ failure. Fatality rates are high; over 55% of the more than 275 people infected with highly pathogenic H5N1 (mostly in Asia) have died.¹⁰ Officials worry that the virus could mutate or combine with human flu viruses to allow efficient human-to-human transmission, which could lead to a human flu pandemic.

If highly pathogenic H5N1 is found in the Americas, it does not signal the onset of a global human pandemic. The virus has not yet mutated to allow human-to-human transmission, and scientists disagree on the likelihood of this happening.

⁷ For more background on select agents, see CRS Report RL32521, *Agroterrorism: Threats and Preparedness*, by Jim Monke.

⁸ A. M. Kilpatrick et al., "Predicting the Global Spread of H5N1 Avian Influenza," *Proceedings of the National Academies of Science* (Dec. 19, 2006), pp. 19368-19373.

⁹ For more on public health issues, see CRS Report RL33145, *Pandemic Influenza: Domestic Preparedness Efforts*, by Sarah A. Lister.

¹⁰ WHO, "Confirmed Human Cases of Avian Influenza A (H5N1)," at [http://www.who.int/csr/disease/avian_influenza/country/en].

Food Safety. No epidemiological evidence exists indicating that people have been infected with any avian flu virus, including H5N1, from properly cooked poultry or eggs. The virus is killed at conventional cooking temperatures (160° F), making properly cooked poultry safe. However, highly pathogenic viruses such as H5N1 can spread to nearly all parts of an infected bird, survive in raw poultry, and be spread if contaminated poultry is marketed and prepared.¹¹ Thus, the Centers for Disease Control and Prevention (CDC) and the USDA Food Safety and Inspection Service recommend standard food safety practices, such as those for preventing infection from *Salmonella* and *E. coli*.¹²

The vast majority of poultry and poultry products in the United States are produced in large-scale, commercial poultry farms under strict veterinary control. Infected poultry are very unlikely to enter the food chain, as nearly all commercial growers participate in avian flu testing programs. When avian flu viruses are found, any infected flocks are destroyed (not slaughtered for food) to preserve food safety and prevent the virus from spreading beyond the infected area. Poultry products from backyard flocks and live bird markets do not receive the same level of inspection as commercial production, but typically are consumed on-farm or in limited distribution circles rather than entering the traditional farm-to-fork food chain. Backyard poultry and poultry bought at live bird markets are not a primary source of food in the United States (less than 1% of poultry).

Control

In the United States, avian flu in poultry is controlled through prevention and eradication by individual farmers cooperating with industry associations and state and federal governments. APHIS is the lead federal agency. Internationally, FAO has a joint response plan with the World Health Organization (WHO) for the current outbreak.

International Control Efforts¹³

As H5N1 spreads, it may become established in countries with inadequate veterinary services or animal husbandry practices. Chances increase that the virus will evolve through mutation or re-assortment into a strain that could be transmitted

¹¹ WHO, “Avian Influenza (AI): Food Safety Prevention Measures,” at [http://www.euro.who.int/eprise/main/WHO/Progs/FOS/Microbiological/20041019_1], and “Highly Pathogenic H5N1 Avian Influenza Outbreaks: Food Safety Implications,” Nov. 4, 2005, at [http://www.who.int/foodsafety/fs_management/No_07_AI_Nov05_en.pdf].

¹² USDA Fact Sheet, “Avian Influenza,” March 2006, [<http://www.usda.gov/wps/portal/usdahome?contentidonly=true&contentid=2005/11/0511.xml>].

¹³ FAO, “Avian Influenza Control and Eradication: FAO’s Proposal for a Global Programme,” FAO, Mar. 2006, at [http://www.fao.org/ag/againfo/subjects/documents/ai/Global_Programme_March06.pdf]; and FAO and OIE, in cooperation with WHO, “A Global Strategy for the Progressive Control of Highly Pathogenic Avian Influenza (HPAI),” Nov. 2005, at [http://www.fao.org/docs/eims/upload//210745/Glo_pro_HPAI_oct05_en.pdf]. See also CRS Report RL33219, *U.S. and International Responses to the Global Spread of Avian Flu: Issues for Congress*, by Tiaji Salaam-Blyther.

easily between humans. Thus, FAO and WHO developed a strategy calling for the swift and coordinated control of avian flu in poultry as the best way to prevent or delay a human pandemic from developing, by reducing the number of animal hosts in which the virus may evolve.

The World Organization for Animal Health (OIE)¹⁴ revised its reporting standards for avian flu in 2006. Previously, only highly pathogenic avian flu was a “reportable disease,” but the new rules include low pathogenicity strains of H5 and H7 avian influenza. Making low pathogenicity H5 and H7 reportable diseases requires exporting countries to upgrade their surveillance and eradication protocols to demonstrate freedom from the disease. USDA accomplished this upgrade with new regulations issued in September 2006 (see below).

Preventing Infection

Biosecurity practices are the most important means of preventing outbreaks in poultry. These practices include preventing contact between wild birds and poultry, and limiting non-essential human access to farm buildings. For example, delivery trucks and personnel are cleaned and disinfected before entering a biosecure area, or moving between farms or barns. In other parts of the world, small farms or backyard flocks without biosecurity practices have posed greater problems for control. Such animal husbandry practices are slow to change.

Surveillance and detection also form an important component of prevention. As discussed earlier in this report, federal and state agencies have increased surveillance of wild birds for H5N1. In 2006, APHIS issued new regulations for the control of low pathogenicity H5 and H7 avian influenza in poultry and a new indemnity program (71 *Fed. Reg.* 56302, Sept. 26, 2006). These regulations (9 C.F.R. § 56, 146, and 147) are voluntary as part of the National Poultry Improvement Plan,¹⁵ but have strong incentives for participation since eligibility for federal indemnity payments are linked to participation in the surveillance program. The first component is diagnostic surveillance of all live poultry under APHIS-approved state-level programs. The second component is a state-level response and containment plan, also needing APHIS approval. The third component is active surveillance of slaughtering plants for meat-type poultry, and egg-laying flocks for breeding flocks and table-egg layers.

¹⁴ The World Organization for Animal Health (known by its French name and acronym Office International des Epizooties, OIE) is an international organization created in 1924 with 166 member countries. It is the world’s official information clearinghouse for animal diseases and health. Member countries report diseases that occur on their territory, and the OIE disseminates the information, allowing other countries to take preventive action based on accepted scientific standards for reporting. The OIE also analyzes scientific information on animal disease control, provides technical support, and develops normative documents that are recognized by the World Trade Organization for international trade and sanitary rules; see [<http://www.oie.int>].

¹⁵ The National Poultry Improvement Plan applies new technologies, establishes standards for disease-free status, and allows uniformity with the goal to improve poultry health and the quality of poultry products. Federal, state, and industry representatives cooperate in setting goals and standards. Participation is voluntary. States administer the program in cooperation with USDA. [<http://www.aphis.usda.gov/vs/npip>].

Vaccines. While vaccination of poultry is possible and has been used on a small scale with some success, it generally is not considered a sufficient control method. Vaccination poses problems for international trade, as many countries will not import poultry products from other countries that use vaccination, since animals could test positive for antibodies either due to vaccination or due to actual infection; distinguishing the difference can be problematic. Moreover, if vaccination is not administered and monitored correctly, it can allow the virus to become entrenched and continue to spread or mutate.¹⁶

In the United States, vaccination is most likely to be used for breeding poultry, egg layers, and other higher value birds. Vaccination in a ring surrounding an eradication zone is another possible vaccination strategy.

In September 2006, USDA's National Veterinary Stockpile had 110 million doses of avian influenza vaccine available for poultry. Within this total, 75 million doses were for H5 viruses such as H5N2 and H5N9, and these vaccines have been shown to be effective against the Asian H5N1 strain. About 35 million doses are for H7 viruses. USDA has plans to acquire access to up to 500 million doses through agreements with vaccine manufacturers.

Eradicating Outbreaks

Because the virus is highly contagious and easily spread in poultry, the most common method of control in an outbreak is to establish quarantines (of birds, contaminated products, conveyances, etc.), restrict movement, and cull the infected flocks and certain flocks in close proximity to the infected flock (also called "stamping out," or depopulating). Following depopulation, buildings and equipment are rigorously disinfected before new birds are allowed, a process that takes at least several weeks. The virus is killed by common disinfectants or heat (about 160° F). Carcass disposal options usually include composting, burial, incineration, or rendering. Affected flocks that are not destroyed eventually may be marketed under controlled conditions with strict waiting periods and additional testing so that the infectious period has passed.

Federal statute allows the destruction of affected animals (9 C.F.R. § 53.4). The USDA National Veterinary Services Lab conducts confirmatory tests on the pathogenicity and type of virus. When the United States does have outbreaks, USDA works to limit restrictions imposed by foreign countries on U.S. exports so that only exports from defined geographic areas actually affected by the virus are banned. USDA also works to lift restrictions once the outbreak is eradicated.

¹⁶ Nicholas Savill et al., "Silent spread of H5N1 in vaccinated poultry," *Nature*, vol. 442 (17 Aug. 2006), p. 757, at [<http://www.nature.com/nature/journal/v442/n7104/pdf/442757a.pdf>]. Ilaria Capua and Stefano Marangon, "Vaccination for avian influenza in Asia," *Vaccine*, vol. 22 (2004), at [http://www.oie.int/eng/avian_influenza/vaccination%20in%20asia.pdf], and Ilaria Capua and Stefano Marangon, "The use of vaccination as an option for the control of avian influenza," Proceedings of the 71st General Session of the OIE, May 2003, at [http://www.oie.int/eng/avian_influenza/a_71%20sg_12_cs3e.pdf].

Domestic outbreaks usually are managed through joint federal, state, and industry cooperation. States usually lead the response for depopulation and quarantines of surrounding areas that are imposed until the disease is eradicated. APHIS provides personnel and equipment to advise and supplement state resources. As part of the National Veterinary Stockpile, USDA has assembled pallets of personal protective equipment (PPE) and other response equipment that can be used when state resources are inadequate. In highly pathogenic avian flu outbreaks, APHIS may take a larger role. In 2006, APHIS published a “National Highly Pathogenic Avian Influenza Response Plan” that outlines all aspects and expectations for the response activities.¹⁷

Compensation for Farmers. Compensation (indemnity) programs are desired to encourage farmers to report outbreaks and cooperate with control programs when culling is needed. States generally manage indemnification programs for low pathogenicity outbreaks. Some industry associations, such as those on the Delmarva peninsula (Delaware, Maryland, and Virginia), have compensation funds.

For highly pathogenic outbreaks, USDA has a long-standing regulation allowing 100% indemnification for highly pathogenic outbreaks of avian flu (9 C.F.R. § 53.2).

In 2006, USDA began a new indemnity plan for low pathogenicity avian flu.¹⁸ This program (9 C.F.R. § 53.6) will pay up to 100% indemnity for the market value, destruction, and disposal of poultry destroyed in an outbreak, and for the cleaning and disinfection of premises, conveyances, and materials. To qualify for 100% compensation, both the state and the commercial grower must participate in federal and state surveillance plans; otherwise the compensation rate is only 25%. An exception allows small growers to receive 100% compensation, regardless of participation in the surveillance plan. Thus, given expected participation rates among commercial growers and states, nearly all producers and states will qualify for 100% indemnification in an H5 or H7 outbreak. Funds for such indemnities likely would come from the Secretary’s authority in 7 U.S.C. § 8316 to transfer money for animal health emergencies, most likely from the Commodity Credit Corporation.¹⁹

Economic Impacts

Avian flu can affect the agricultural economy significantly. Because the extent of such an outbreak is highly uncertain, no quantitative economic estimates of an H5N1 outbreak in the United States are provided here. Usually, direct costs include

¹⁷ USDA APHIS Veterinary Services, “National Highly Pathogenic Avian Influenza Response Plan,” (Aug. 2006), at [http://www.aphis.usda.gov/newsroom/hot_issues/avian_influenza/avian_influenza_summary.shtml].

¹⁸ A limited indemnification program was created for a 2002 LPAI outbreak in Texas and Virginia (formerly 9 C.F.R. § 53.11; removed by the new indemnity plan in 9 C.F.R. § 56).

¹⁹ For more background on emergency funding for animal health emergencies, see CRS Report RL32504, *Funding Plant and Animal Health Emergencies: Transfers from the Commodity Credit Corporation*, by Jim Monke and Geoffrey S. Becker.

culling birds and quarantining farms. Larger economic effects arise from international trade bans which affect farms outside the quarantine area.

The 1983-1984 outbreak of highly pathogenic avian flu in the United States caused the destruction of 17 million birds and cost \$65 million. In the small 2004 domestic outbreak, about 400,000 chickens were culled in the United States. While this was less than 0.02% of U.S. broiler production, the effect on local regions and farms was much greater. The potential economic impact of a highly pathogenic H5N1 outbreak in the U.S. likely could be many times larger.

In the current H5N1 outbreak, global consumer confidence is increasingly at stake despite official statements that normal cooking would kill any virus that might be present. With strong consumer confidence, demand for *healthy* poultry may rise. But weak consumer confidence could depress poultry prices (globally or locally) and raise demand for substitute meats such as beef or pork. In a recent domestic survey, 46% of chicken eaters said they would stop eating chicken and another 25% said they would eat less chicken if avian flu entered the United States.²⁰ In 2006, consumer demand for poultry dropped in Europe and Africa. Lower shipments to Eastern Europe and Central Asia depressed U.S. poultry prices in 2005.²¹

Demand for feed such as corn and soybean meal is tied to poultry production. Poultry accounts for about one-third of world feed use. So far, the global impact on feed has been limited due to relatively quick recovery of production where outbreaks were contained, since the production cycle is quite short (about eight weeks).

The United States is the world's largest producer and exporter of poultry meat and the second-largest egg producer. About 8.5 billion broilers are produced annually (**Figure 2**), worth over \$23.3 billion on the farm (22% of farm livestock sales, and 12% of total farm sales including crops). Broiler production accounts for about \$15 billion, eggs \$5 billion, and turkeys nearly \$3 billion. Five states account for 60% of U.S. production: Georgia (15%), Arkansas (14%), Alabama (13%), Mississippi (9%), and North Carolina (9%). About 16% of U.S. poultry production is exported.

Internationally, the ongoing H5N1 outbreak has affected small poultry farms and backyard farmers in particular, but also large-scale poultry farms, feed suppliers and poultry processors. The effects have been particularly acute in certain Asian countries where culling has been extensive or recurring. In developing countries, poultry farming represents a significant source of income and wealth. Poultry also may be an important source of protein, causing nutritional problems if culling is extensive or prolonged. Many observers have called for greater assistance to developing countries for compensation programs to encourage early reporting of

²⁰ Harvard School of Public Health, "Project on the Public and Biological Security" (Jan. 17-25, 2006), at [<http://www.hsph.harvard.edu/press/releases/press02232006.html>].

²¹ FAO, "Escalating bird flu crisis jeopardizes global poultry trade prospects" (Feb. 28, 2006) at [<http://www.fao.org/newsroom/en/news/2006/1000240/index.html>], and USDA Economic Research Service, "Livestock, Dairy, and Poultry Outlook," February 15, 2006 (monthly), at [<http://www.ers.usda.gov/publications/ldp>].

Federal Appropriations to Control Avian Flu

Funding for avian flu is scattered in a number of agencies. For poultry, the primary agency is APHIS, with some research funds allocated to the Agricultural Research Service (ARS) and the Cooperative State Research, Education, and Extension Service (CSREES). For wild birds, the primary agencies are APHIS, plus the Fish and Wildlife Service (FWS) and the Biological Research Division in the U.S. Geological Survey (USGS), two Interior agencies.

Poultry. For FY2008, the Administration is requesting \$82 million for avian flu: about \$77 million for APHIS and \$5 million for agricultural research. These are the same amounts that the Administration requested for FY2007. Within APHIS, the Administration requests \$57 million for the HPAI monitoring and surveillance program, and \$17 million for the LPAI disease management program (each increase is about 50% from respective FY2007 estimates).

For FY2007, USDA generally is operating at FY2006 levels, with various adjustments, under the year-long continuing resolution (P.L. 110-5). APHIS received a \$30 million increase (+3.7%) for all of its programs, largely because of concerns over avian flu, but the continuing resolution does not specify an avian flu allocation within APHIS. USDA budget documents suggest about \$37 million for a new HPAI monitoring and surveillance program, and \$11 million for the LPAI disease management program.

For FY2006, the regular appropriation to APHIS for its LPAI program was \$13.8 million (but with carryover, \$28.3 million was available, with about \$12 million for indemnities; P.L. 109-97, H.Rept. 109-255). In addition, Congress appropriated \$91.4 million in emergency supplemental funds for USDA as part of \$3.8 billion for pandemic influenza (Division B, Title II, of P.L. 109-148). From the supplemental, APHIS received \$71.5 million for domestic surveillance, diagnosis, and vaccine stockpiles; and for international technical assistance for surveillance, biosecurity, and control.

In FY2005, Congress appropriated \$23.8 million to APHIS for avian flu, with about half for the indemnity reserve. In FY2004, APHIS received a \$1 million appropriation. USDA also transferred \$13.7 million in emergency funds during the 2004 outbreak.

Wild Birds. For FWS General Operations, the Administration proposed \$7.4 million for HPAI in FY2008, the level Congress provided to FWS in FY2006. The program covers the study, monitoring, and early detection of HPAI. FWS is to cooperate with other federal and non-federal agencies in studying the spread of the virus through wild birds. Attention has been focused on the North American species whose migratory patterns make them likely to come into contact with infected Asian birds. A special geographic focus is on Alaska, the Pacific Flyway (along the west coast), and Pacific islands (see **Figure 1**). The House Appropriations Committee report in FY2007 also directed that the funds be used not only for monitoring and testing in Alaska, but also for “vector control efforts in other areas,” but did not elaborate on the efforts intended nor the geographic areas to be given additional emphasis. The Senate report did not discuss the program.

Under the Terrestrial and Endangered Resources sub-activity, USGS is conducting investigations related to HPAI. In cooperation with FWS and other federal and state agencies, USGS began targeted surveillance for the early detection of HPAI in wild birds in Alaska in 2005, and to date has collected over 45,000 detailed records from around the country for its database. A steering committee was formed in 2006 to coordinate efforts and establish standard operating procedures for sampling and analysis. For 2008, the USGS will work with other partners to continue sampling birds for HPAI and coordinate with other agencies to deal with avian influenza in North America. The Administration requested \$36.8 million for FY2008 for Terrestrial and Endangered Resources, up \$5.3 million over FY2006. The agency did not provide a separate figure for HPAI-related investigations within the sub-activity. The House-passed bill and Senate Appropriations Committee bill approved these increases.