A Collaborative Research Project Funded by:

DFID Department for International Development

Implemented by:

INTERNATIONAL FOOD POLICY RESEARCH INSTITUTE
IFPRI

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INTERNATIONAL LIVESTOCK RESEARCH INSTITUTE

RVC Royal Veterinary College University of London

Controlling Avian Flu and Protecting People's Livelihoods in Africa and Indonesia

HPAI Research Brief | No. 6 – Year: 2009

Pro-Poor HPAI Risk Reduction Strategies: Synthesis of Country Background Papers

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Key Findings

- Poultry provides a sustainable income at minimal investment as well as security against risk and is a cheap source of protein, especially for poor households in developing countries. Hence, it is important to emphasize the relationship between livelihood and poultry in designing pro-poor HPAI control strategies.
- There is need for a more rigorous consideration of the links between scale of production and biosecurity in order to have a uniform structure for the poultry system, particularly backyard poultry.
- Many efforts have been made to mitigate the risk of HPAI as well as to develop strategic and emergency preparedness plans for its prevention and control, but the cost-effectiveness of these efforts remains to be determined, particularly in an endemic HPAI situation.

This brief is a synopsis of five country background papers that provided an inventory of information about the importance of the poultry sector in the economy and for rural livelihoods, the structure of the poultry sector and the associated level of biosecurity, and the threats and incidences of highly pathogenic avian influenza (HPAI), along with prevention and control measures that were implemented and the institutional response capacity (See Alemu et al. 2008, Aning et al. 2008, Obi et al. 2008, Omiti and Okuthe 2008, and Sumiarto and Arifin 2008 for more details). The countries investigated were Ethiopia, Ghana, Indonesia, Kenya, and Nigeria.

Incidences of HPAI outbreaks in the world have continued since the first confirmed one in 2003. The virus is still circulating and remains a threat to public health. In 2006, a total of 47 countries reported HPAI in their domestic poultry, with repeated outbreaks in Bangladesh, China, Thailand, and Vietnam. It is considered endemic in several countries, including two that were studied: Indonesia and Nigeria. (See Table 1.) The endemic nature of the disease in these countries constitutes a permanent source of potential contamination for humans and could also be a source of contamination for other countries through legal and illegal movements of animals.

Table 1. Status of HPAI in study countries, as of June 2008

Country	Number of outbreaks (by state or region)	Dates	Culled poultry	Poultry deaths	Human deaths	Status
Ethiopia	—	—	15,000 (approx)	NA	None	Free
Ghana	3	14 April – 13 June 2007	27,358	13,371	None	Sporadic
Indonesia	31	August 2003 – Present	11.5 million (approx)*		110	Endemic
Kenya	—	—	Unknown	NA	None	Free
Nigeria	25	January 2006-October 2007	1,250,343	222,780*	1	Endemic

*Note: Data on culled birds shown reflect estimated data for 2004 and 2006 only.

Tables 2, 3, and 4 provide overviews of the responses to avian influenza threats and preparedness activities by the government and the private sectors in each of the study countries. The national plans developed by the governments have focused on:

- the improvement of animal health,
- functioning veterinary and human health systems,
- coordinated action for pandemic preparedness, and
- social mobilization and communication.

In some cases there have been significant enhancements in AI detection capacity, surveillance and reporting systems, animal disease controls, and compensation arrangements.

Table 2. Responses of governments to HPAI outbreaks in study countries

Country	Response of Governments
Ethiopia	Established a national task force, which set up technical committees Drafted a $43-million budget for possible control measures Set up crisis management team for avian flu and developed the national preparedness plan Outbreak investigations and surveillance on poultry and wild birds
Ghana	Public declaration of outbreaks by Minister of Food and Agriculture Intensification of public awareness campaign to highlight the roles of migratory birds, movement of infected poultry, and import of contaminated poultry products Established sero-surveillance/ epidemio-surveillance (active and passive search for the disease in the infected area and beyond)
Indonesia	Established a national committee on avian influenza control (KOMNAS) to coordinate the implementation of the National Strategic Plan on AI Control and Influenza Pandemic Preparedness at the national and local level Engaged nongovernmental organizations (NGOs) and civil society in planning Launched a national public awareness campaign to promote behavior change and to raise awareness to reduce the risk of human exposure to HPAI Implemented standard procedures and systems for communicating outbreak observations and reporting between the government, technical agencies, hospitals Implementation of compensation policy for culled poultry
Kenya	Completed a national action plan Strengthened surveillance Launched awareness programs Placed veterinary personnel at entry points on alert Trained veterinarians and para-veterinarians to strengthen the surveillance system Strengthened laboratory diagnostic capacity

	Established strategy for possible destruction of birds and disposal of carcasses Engaged the private sector with the coordinating committee for effective mobilization Increased awareness among small-scale farmers and poultry producers
Nigeria	Put plan in place for restocking poultry once bird flu outbreak is confirmed UNCT established a national task force and state-level committees to help in preparedness and response Government established a Crisis Center to link with affected areas Teams from FAO, WHO, and U.S. Centers for Disease Control and Prevention training Nigerian health and veterinary workers in controlling the virus Engaged NGOs and civil society in preparedness and planning Conducted socioeconomic impact studies of HPAI

Table 3. Responses of private sector to HPAI outbreaks in study countries

Country	Response of Private Sector
Ethiopia	Individuals importing food became responsible for ensuring compliance with food safety from the country of origin Exporters responsible for ensuring compliance of goods with food safety standards, quality, and nutrition
Ghana	Anecdotal information suggests that some farmers quit because of the ban on the sale of poultry and poultry products
Indonesia	Implemented standard procedures and systems for communicating outbreak observations and reporting between the government, technical agencies, hospitals Launched a national public awareness campaign to promote behavior change and to raise awareness to reduce the risk of human exposure to HPAI
Kenya	Farmers reduced size of poultry flocks for fear of the avian flu, lack of market for their products, and low demand and prices for broilers Loss of revenue due to panic and premature selling of poultry in an attempt to get rid of stock and reduce chances of poultry contracting avian flu Commercial integrated operations suffered losses as a result of cancellation and reduced booking for day-old chicks Peoples' attitudes toward chicken greatly affected by initial media coverage of avian flu; public awareness campaigns aimed to enlighten individuals about the spread and nature of the disease
Nigeria	Community leaders trained in identifying risky behaviors, attitudes, perceptions, and beliefs before, during, and after AI outbreaks

Table 4. Control measures in response to HPAI outbreaks in study countries

Country	Control Measures
Ethiopia	Banned all poultry imports and poultry machinery from countries with HPAI outbreaks Strengthened controls on cross border trade
Ghana	Quarantine of infected farms and standstill measures as required Ban on the movement of poultry and poultry products in and out of infected area Culling of affected and in-contact animals Paid compensation to owners of destroyed animals; rates vary between 70% and 90% of the market price Decontamination and disinfection of premises, vehicles, etc. infected by the virus Closure of wet poultry markets in the area

Indonesia	Selective stamping out Selective vaccination Surveillance Compensation to layer farms with fewer than 10,000 hens and broiler farms with fewer than 15,000 bird per cycle Credit schemes for farms infected with HPAI Increased biosecurity to prevent contact or spread; targets: commercial and backyard farms Control movement of live poultry, poultry products, and farm waste
Kenya	Epidemio-surveillance (includes both active and passive surveillance) Import ban Banned import of poultry and poultry products from all affected countries Quarantine; delineation/zoning Culling Disinfection of persons, materials, equipment, and vehicles infected by the virus Movement control
Nigeria	Quarantine Eradication Restocking poultry once bird flu outbreak is confirmed Compensation to farmers whose birds were destroyed, at 30–40% of the market value

Effectiveness of Current Policies, Laws, and Regulations

The effectiveness and success of policies, laws, and regulatory systems related to the poultry sector and HPAI depend on the following factors:

- a strong commitment to ensure implementation at the highest political level, accompanied by effective leadership of all concerned stakeholders;
- clear procedures and systems for managing the rapid implementation of priority actions;
- improved functioning of veterinary and human health services at all levels, with a transparent approach to the sharing and dissemination of information about suspected disease outbreaks, immediate efforts to establish their cause, and prompt responses;
- incentive and/or compensation schemes combined with effective communication to communities on the importance of immediately reporting animal disease outbreaks to responsible authorities;
- effective mobilization of civil society and the private sector; and
- national mass communication campaigns that promote healthy behavior and focus on reducing the extent to which humans might be exposed to HPAI viruses.

In all five study countries the rapid response to HPAI—which included setting up inter-sectoral national task forces, frequent task force meetings, and the governments' financial support to put strategic plans into action—indicated strong political commitment to ensuring HPAI strategy implementation. Each national task force has established a subcommittee for communications to raise public awareness of the risk of exposure to HPAI and the importance of disease outbreak reporting. Table 5 summarizes the effectiveness of selected preventive and control measures in each country.

Table 5. Effectiveness of preventive and control measures in reducing the risk of HPAI outbreaks in study countries

Control measure	Ethiopia	Ghana	Indonesia	Kenya	Nigeria
Public awareness campaign	Yes, but reduced demand for poultry in the short term	Yes, but reduced consumption of poultry	Yes, but reduced demand for local poultry and increased that for foreign poultry	Yes, but reduced demand for poultry	Not very effective
Surveillance	Yes	Yes	Yes	Yes	Yes
Culling	Yes	Yes	Yes	No	Yes
Compensation	—	Yes	Yes	No	Yes, but not to the wider population of poultry farmers
Decentralization of control	No	Yes	Yes	Yes	Yes
Restructuring	Yes	No	Yes	No	No
Import bans	No	No	Yes	Yes	No
Traceability of movement of birds	Highest in industrialized sector and large commercial poultry farms	High in industrialized sector and large commercial poultry farms	High in industrialized sector and large commercial poultry farms	High in large and small commercial poultry farms	High in industrialized sector and large commercial poultry farms

Several constraints impede the effectiveness of implementing control strategies. Among these are the lack of funding to put plans into action, of inter-sectoral coordination, of restructuring of the poultry industry, and of a regulatory framework for biosafety that safeguards the livelihoods of poor and backyard farmers. Moreover, less emphasis has been placed on assessing the effects of mitigation and control strategies on the livelihoods of smallholder farmers in developing countries. It is very possible that the larger the impact, the less incentive a smallholder has to adopt a proposed control strategy.

Economic Contributions of the Poultry Sector

Pork and poultry are the prominent contributors to agricultural growth in developing countries. Despite sluggish poultry production growth relative to the rest of the world, Food and Agriculture Organization (FAO) statistics suggest that all five study countries experienced increasing growth in production over the period 2000–05. If the poor fail to remain active in these sectors, they will miss a tremendous opportunity to improve their livelihoods. Small-scale producers depend on poultry for their livelihoods, food security, and nutritional needs. Poultry has been recognized as one of the new income-generating activities, especially for women, who are increasingly involved in the sector.

In several developing countries affected by HPAI, smallholders bear most of the burden of the costs of HPAI outbreaks, even though the costs per household may be negligible due to the small size of flocks compared with larger producers. This makes it difficult for decision makers to determine how best to implement control and prevention strategies, particularly when poor households may be unable or unwilling to change their management practices without financial and technical assistance. It is therefore worrisome if the measures to control zoonotic disease such as HPAI are extensively implemented without carefully taking into account the ability and capacity of smallholders to adopt measures that might displace them.

In **Ethiopia**, poultry represents a fairly small share of total livestock output relative to other types of livestock. Although there has been a net increase, chicken production and consumption have fluctuated from year to year, with a noteworthy plummet from 2003 to 2004. **Ghana** experienced relatively high poultry production growth rates between 2000 and 2005, although the actual level of production remains quite low. Ghana imports most of its poultry in order to meet domestic demand. Yet village poultry rearing there provides substantial support to rural households. The government of **Nigeria** reports that the country produced 4 million tons of poultry meat in 2004–05, representing about 17% of total meat consumption during this period.

Of the five countries, **Indonesia** has the highest poultry production both in terms of quantity produced and growth rate. Live chicken and egg production have been increasing despite the adverse effect of avian influenza (AI) outbreaks since 2003. **Kenya** is generally self-sufficient in eggs and poultry meat in terms of production. Two-thirds of Kenyan households keep at least one type of livestock, and 67% of these households raise chicken.

Unfortunately, there are inconsistencies and discrepancies in these data on poultry production because they come from different sources, and each source used a different definition and classification of the poultry operations.

On the global scene, trade in poultry meat is growing and is projected to increase faster than production and consumption. Among the five study countries, live poultry as a traded product is most important in **Ghana**, which mainly imports meat from countries that are AI free and which exports some eggs. Poultry imports in 2000–04 increased by about 1200%. **Kenya** does not import or export any chicken meat, but other poultry products are traded. Kenyan poultry products, especially hatching eggs and day-old chicks (DOCs), are exported to neighboring countries—Uganda, Tanzania, and Ethiopia—none of which has so far reported any incidence of HPAI.

In **Nigeria**, most of the inputs in poultry production are imported from Asia, Europe, and the United States. In 2003, Nigeria imported live birds from the United Kingdom and the European Union, Hong Kong, and other Asian countries where HPAI outbreaks have occurred. Nigeria also imports products of animal origin from neighboring countries like Ghana and Cameroon. In **Ethiopia**, trade in poultry and poultry products is also concentrated in importation of live birds and DOCs. Large-scale intensive poultry farms and multiplication centers mainly depend on importing day-old chicks. As of early 2006, however, Ethiopia only allowed imports from exporting countries free of HPAI.

The series of outbreaks of HPAI in **Indonesia** reduced the export value of live poultry there between 2004 and 2006. Export of day-old chicks was stopped in 2004 and 2005 because there was no

demand for them from neighboring countries. Similarly, the export value of chicken meat from Indonesia declined by 88%. Indonesia's imports of live birds also decreased over the period 2003–06.

Importance of the Poultry Sector to Nutrition of the Poor and Livelihoods

Poultry is a significant livelihood asset, especially for backyard poultry producers in both rural and peri-urban areas, whether for consumption or commercial purposes. Backyard poultry accounts for 80–90% of the total poultry population in each of the study countries. It is considered an essential economic activity, particularly to poor rural households because it requires very little labor, low inputs, and low investment and has high reproduction rates. An acute outbreak of avian influenza, which could be a short one, may have a major impact on backyard small and medium-scale producers; given their small profit margins, they may end up going out of business because they do not have enough resources to sustain themselves until the disease is eradicated. Substantial removal of poultry from poor producer households reduces their cash income and their funds to buy other types of food, and thus deprives them of the opportunity to escape poverty and food insecurity.

As in any other poultry disease, the direct economic impact of HPAI includes income declines due to lost poultry and egg outputs, lower consumption, lower prices, trade restrictions, and reduced production efficiency. There are also economic consequences associated with public and private efforts to prevent the introduction or spread of HPAI and to deal with its effects, such as the costs associated with movement restrictions, quarantine, surveillance, vaccination, depopulation, disposal of carcasses and waste products, and cleaning and disinfection.

HPAI can also affect human health by reducing the availability of poultry meat and eggs for consumption, particularly among poor households who rely on their own production as their major source of animal protein and are less likely to be able to afford other protein-rich meat products. It is known that poultry is the most affordable source of protein, and this remains true even after the AI outbreaks. Poultry is also a rich source of highly bioavailable essential micronutrients, such as iron, Vitamin A, and zinc. Consuming just small amounts of poultry meat or eggs can make a large difference to micronutrient intake. Women and children often are at risk of micronutrient deficiencies, particularly iron deficiency. Infants and young children are more likely than other family members to be fed eggs, and the absence of eggs in their diet could significantly reduce their intake of essential micronutrients. Micronutrient malnutrition in children can stunt growth and lower the immune system and consequently increase levels of morbidity and mortality.

Among the five study countries, consumption of eggs per capita appears to be lowest in Ethiopia and highest in Indonesia; consumption of chicken meat per capita is lowest in Kenya and highest in Indonesia. Per capita consumption of chicken meat did not decrease in the study countries after 2003 except in **Kenya**, although poultry remains a major source of animal protein there and is generally part of the Kenyan household diet. Even though poultry production is on the rise in Kenya, it is not sufficient to meet the demand of a fast-growing population. In **Ghana**, in contrast, consumption of chicken meat per capita has increased substantially, but egg consumption remains low even though its production has increased slightly. Chicken and eggs are dominant in the **Indonesian** diet. Demand for poultry products in Indonesia is very elastic, which makes it very

sensitive to income changes. In addition, when the prices of poultry products increase, consumers easily substitute beef, fish, etc.

The average **Nigerian** consumes only about 7 grams of animal protein per day compared with the minimum daily requirement of 28 grams. In **Ethiopia**, rural households consume a limited quantity of poultry products since they rank cash income as the primary purpose of village chicken production. Poultry consumption is closely associated with wealth status. The poorer the household, the fewer poultry products are eaten. Chickens are not a daily food in Ethiopia even in a better-off household.

In terms of the importance of this sector to livelihoods, the poultry sector in **Indonesia** contributed 1.8% of agricultural gross domestic product (GDP) in 2006. The rate of growth of the livestock sector was 4.5% per year between 2001 and 2006, which was quite high compared with the negative growth of 1.9% from 1998 to 2000. Interestingly, the livestock sector's share of GDP has started picking up again after the crisis, and the poultry sector is the major contributor to the rapid growth, despite AI outbreaks in several parts of Indonesia since 2003, with 16.2 million poultry killed or stamped out in control efforts. The losses in terms of bird cost alone were between $16.2 million and $32.4 million.

In **Ghana**, livestock and poultry together contributed 7% of the national agricultural GDP of 40.6% in 2005. Poultry is an important domestic source of meat, contributing about 25% to total domestic meat production between 2000 and 2004. Anecdotal evidence shows that the intensive poultry industry plays a key role in supplying poultry meat and eggs to urban markets at a competitive price. The industry also provides employment for a range of workers, from poultry attendants to truck drivers and professional managers. One study in Greater Accra suggested that over 80% of respondents kept free-range village chicken to supplement their incomes. They concluded that most households perceive income from chicken sales as only a minor source of cash for the household, contributing an average of about 15% to total household income.

The poultry sub-sector contributes about 55% to the livestock sector in **Kenya** and 30% of the agricultural GDP or 7.8% of the total GDP. The sub-sector employs about 2 million people directly in production and marketing and indirectly through linkages with suppliers of inputs. The food industry where poultry products are mainly consumed is highly integrated with tourism. The poultry sector is also linked with sports (cock fighting) and agricultural shows. Raising poultry was found to be an important income-generating activity in 319 households that were sampled from eight districts in Kenya, where it contributed 73% of the household income. Poultry is an important source of food, as there are few alternative animal protein sources available for the poor. Meat and eggs are usually consumed in rural areas only during special occasions.

The contribution of poultry meat and eggs to total livestock output in **Nigeria** stood at 27% in 1999. The contribution of village poultry to the national economy of Nigeria has been significant over the decades. Poor smallholders depend a lot on poultry production; hence, the economic impact due to disease outbreak is greater, due to difficulties in overcoming the costs of culling and restocking in the presence of an outbreak.

Thus the importance of this sector for people's nutrition and livelihood cannot be overemphasized, as poultry provides a sustainable income at minimal investment as well as security against risk and is a cheap source of protein, especially for poor households in the developing world.

Poultry sector structures and marketing systems

Over the years there have been numerous attempts to describe and differentiate poultry production systems since there are various methods of rearing poultry—from large-scale, vertically integrated industrial farms to village-level, subsistence, and scavenging poultry operations. (See Tables 6 and 7.) One classification was based on flock sizes and genetic breed, such as intensive, semi-intensive, and extensive and scavenging. The poultry sectors in most African countries have been classified in these categories.

The intensive system, based on specialized breeds, is used for less than 30% of the total poultry population in Africa. It is found mainly in urban areas, where there are markets for eggs and chicken meat. In countries that followed a socialist policy, such as Ethiopia, the intensive poultry production system was confined to government institutions. Intensive and semi-intensive production systems are based on one species, most frequently the domestic chicken. Flock sizes in intensive production systems are normally in the thousands, whereas the semi-intensive or backyard production flocks range from 50 to 200 birds. The extensive poultry production systems in Africa, where poultry are kept free range or allowed to scavenge, are different from more-recent extensive free-range poultry situations in industrial countries.

Table 6. Characteristics of the poultry production systems in study countries

Characteristic	Industrial and integrated	Commercial not integrated	Backyard market-oriented	Village or backyard subsistence
Bird and output marketing	Commercial; export and urban	Usually commercial; urban/rural	Birds usually sold in live bird markets urban/rural	Birds and products consumed locally; rural/urban
Use of purchased inputs	High	High	High	Low
Dependence on good roads	High	High	High	Low
Location	Near capital and major cities	Near capital and major cities	Smaller towns and rural areas	Everywhere; dominates in remote areas
Birds kept	Indoors	Indoors	Indoors/ part-time outdoors	Outdoors most of the day
Shed	Closed	Closed	Closed/open	Open
Veterinary service other than in epizootic disease control	Own veterinarian	Pays for veterinary service	Pays for veterinary service	Irregular, depends on government services
Source of medicine and vaccine	Company or market	Market	Market	Government and market
Source of technical information	Company and associated	Sellers of inputs	Sellers of inputs	Government and extension
Source of finance	Banks and own	Banks and own	Banks and private	Private and banks
Breed of poultry	Commercial	Commercial	Commercial	Native

Table 7. Number of birds kept, by production system, in study countries

Country	Industrial and integrated	Commercial not integrated	Backyard market-oriented	Village or backyard subsistence
Ethiopia	10,000 or more	5,000 or fewer to 10,000	500-1,000	15 or fewer to 500
Ghana	10,000 or more	1,000–5,000	150–500	3–200
Kenya	10,000 or more	100–1,000	50–100	20 or fewer
Nigeria	5,000 or more	1,000–4,999	50–999	5–49
Indonesia	10,000 or more	1,000-5,000	500-1,000	50 or fewer to several hundreds

The marketing system in the five study countries can be characterized as fragmented and involves small-scale/backyard operations. (See Table 8.) A common feature among these backyard poultry farms is their preference for raising local or native breeds, prompted by a number of factors, including taste and texture of meat and cultural practices. Poultry sales in this category are derived from market-based relationships and not from any integrative linkage with traders or other actors along the marketing and distribution chain. Regardless of the scale of production, most farmers sell live chicken at local markets, with most slaughter taking place at the market or in consumers' homes.

Table 8. Market structure of poultry in the five study countries

Indicator	Ethiopia	Ghana	Indonesia	Kenya	Nigeria
Poultry marketing:					
Industrial /integrated	Commercial	Commercial	Commercial	Commercial	Commercial
Large-scale commercial	Commercial/ traditional	Commercial/ traditional	Traditional	Commercial	Commercial
Small-scale commercial	Supermarket	Traditional/ live bird markets	Traditional/ live bird markets	Commercial/tr aditional	Live bird markets
Backyard/village	Live bird markets/ household	Live bird markets/ household	Live bird markets/ household	Traditional/ household	Live bird markets/ household
Poultry price changes after avian flu	Dropped by approximatel y 40%	Price for a crate of eggs dropped by approximately 60%	Approx. 10–35% drop in farmers' profits from sale of poultry	Approx. 13% drop in sale of broilers and 27% drop in sale of indigenous chicken	Chicken prices dropped by about 81% to as much as 90%
Vertical integration	Moderate	Moderate	Weak	Fairly strong	Weak
Geographi-cal concen-tration of commercial poultry producers	In and around Addis Ababa and other urban areas	Three major regions in the South (Greater Accra, Ashanti, and Brong-Ahafo)	Island of Java and the Yogyakarta Special Territory	Capital city and urban areas	Most in Oyo State; others in Ondo, Kaduna, and Ogun

Biosecurity Measures

Biosecurity measures involve the application of health control measures to prevent or reduce the risk of disease introduction and spread. The goal is to build and maintain effective barriers to the entry of unwanted pathogens. These may be physical barriers or barriers created by specific operational procedures.

Each activity that uses materials or equipment being brought into the farm represents a potential threat to farm biosecurity. Minimizing the risk of introduction of pathogens requires sound management of biosecurity measures. At the end of each production cycle, for example, poultry are moved off the farm to slaughterhouses or markets. This would require movement of poultry collectors and their equipment, such as vehicles and crates (or transport cages), onto the farm. Thus, appropriate measures such as crate and vehicle cleaning and disinfecting prior to use on the farm are required to ensure that these activities do not introduce unwanted pathogens.

Farm biosecurity has as much to do with the behavior of workers and compliance with operational procedures on the farm as it does with the quality and range of physical facilities. Although fences and disinfectant footbaths can help reduce risks, these are of limited value if restrictions on entry of visitors are lenient or if procedures for replenishing disinfectant footbaths are not followed. In addition, wild birds pose a potential risk to biosecurity because they can transfer pathogens to farms. Those practicing high-level biosecurity take steps to minimize the risk of contact with these birds—both direct contact (e.g., netting to prevent entry of birds) and indirect contact (e.g., treatment of water from sources frequented by wild birds).

In the study countries, most poultry producers still maintain small flocks, which are kept free-range and are exposed to outside influences. At the same time, these small backyard producers may be interspersed with large-scale commercial operations, which use high levels of biosecurity to prevent the introduction of disease. In Indonesia, for example, sufficient vaccination efforts against AI are taken in 100% of breeding flocks and some 80% of commercial layer flocks, but there are few if any biosecurity measures in Kampong or village chicken.

In **Ethiopia**, the biosecurity of backyard poultry production systems is very poor. In contrast, recent improvements at breeder centers include strong sanitary measures, regular vaccinations, heavy disinfections, controlled movement of the flock and employees, strengthened sanitary facilities, cleaning of wild bird nests, and close observations and chasing of wild birds. Yet issues still needing attention urgently include the selling of poultry waste for animal feed, exchange of sacks and lack of biosecurity and hygienic measures at feed processing plants, inadequate bird slaughtering and packaging facilities in many commercial poultry facilities, and the sourcing, handling, and storage of poultry products in supermarkets.

Producers in **Ghana** do not seem to practice high biosecurity on the farm or at live bird markets. For breeders and hatcheries, however, biosecurity practices are fair to moderately high: vehicles and equipment, packaging material, and staff used for hatching eggs are sanitized before and after visits to the farm, but these hatcheries may not have proper disposal arrangements on the farm for non-hatching eggs, unhatched eggs, culled chicks, and contaminated packaging materials. And at

commercial poultry farms, biosecurity practices are inadequate to low. Working personnel do not wear protective clothing or footwear; farmers rely on public transport for moving birds; and eggs and the vehicles used to transport birds are not cleaned or sanitized. With free movement of birds from farm to market, contacts with wild birds and other domestic birds are likely to happen. For the backyard or village poultry farms, there is no biosecurity system in place at all.

Some large poultry farms in **Kenya** follow a variety of biosecurity practices, including tire dips and spray systems for vehicles, routine cleaning and disinfection of equipment, incinerators and burial pits for the disposal of carcasses, and restricted entry of materials and birds. Yet the occasional sale of birds from subsistence farms may promote the spread of HPAI. In **Nigeria** the large commercial farms and some smaller ones follow basic biosecurity precautions. Disinfection of containers, vehicles, and other equipment used to transport birds is practiced, for instance, by about 20–30% of the poultry production units.

Overall, resource constraints at the farm and intrahousehold level and in veterinary services in developing countries might prohibit the adoption of control measures used elsewhere, particularly since certain measures (e.g., the destruction of flocks) may affect the production and income opportunities of the rural poor. Moreover, the prohibition of certain production practices, such as allowing domestic animals to co-mingle with wild populations in backyard farming operations and requiring that such animals be raised in enclosed compounds, may not be economically feasible for smallholders. Consequently, alternative disease control strategies in such heterogeneous production systems need to be developed that minimize the risk of disease transmission yet are sensitive to the livelihoods of smallholders.

Conclusions

Although a lot of information on the poultry sector and its role in the economies, livelihoods, and nutrition in five countries has been collected, there is limited information currently available in terms of poultry statistics data (perhaps because of a low economic incentive to collect such data before the AI outbreaks). As much as possible, the Pro-Poor HPAI Risk Reduction Strategies Project will address the information and data gaps that are relevant within the study countries to help decision makers with their preparedness and planning capabilities.

One important gap is related to the standardization of the classification of the poultry production system, which is a crosscutting issue because each study country defines farm sizes differently for each category, and the relationship between farm size and biosecurity is unclear. Thus there is need for a more rigorous consideration of the links between scale of production and biosecurity in order to have a uniform structure for the poultry system, particularly the backyard sector. Backyard poultry farms in all the study countries were defined as those operating under extensive technology, keeping birds at minimal inputs (typically fewer than 50 birds). Large-scale farms, on the other hand, were defined as those using intensive technology, having at least 10,000 birds, and vertically integrated with other actors along the supply chain, such as hatcheries, feedmillers, and processors.

A well-defined classification of the poultry production system would aid in mapping the risk pathways—that is, in understanding the flow and behavior of the HPAI virus and the risk assessment and consequences of HPAI for different regions and stakeholders in the study countries. It would also

be easy to look at the spread of the disease between sectors (for example, backyard to commercial sector) in infected countries and at transmission pathways between poultry sectors.

Another gap that needs immediate attention is the lack of research related to the impact of HPAI on livelihoods of the poor. It is very important to emphasize the relationship between livelihoods and poultry in designing pro-poor HPAI reduction strategies. Chicken and eggs are multiple inputs into the livelihood system: they can be commercial goods that provide household income, for example, or they can serve as food that is a valuable source of protein or provide insurance and social status, particularly for rural poor households. It is therefore important to separately consider each sector in the poultry industry in assessing the effects of HPAI and identifying which group is most likely to be vulnerable to HPAI scares or outbreaks.

The cost-effectiveness of HPAI control measures also needs further research. Many efforts had been made to mitigate the risk of HPAI as well as to develop strategic and emergency preparedness plans for its prevention and control, but the cost-effectiveness of these efforts still remains to be seen, particularly in an endemic HPAI situation.

In addition, there are questions related to incentives and compensation schemes that remain unanswered. Regarding culling of infected birds, for instance, stamping out was applied immediately to affected farms and those within a specified radius. The extent of culling applied in each study country infected with the disease (Ghana, Indonesia, and Nigeria) varied according to the HPAI situation in the country. The provision of compensation and sufficient logistics remained key issues in the success of this control strategy. There is a need to develop a fair and equitable incentive structure and compensation mechanisms to mitigate the risk of HPAI to livelihoods, livestock, and economies, particularly for the poorer poultry keepers. It is therefore vital to assess the economic costs associated with different incentive schemes that could encourage farmers and other concerned players in the poultry industry to adopt cost-effective control measures in a sustainable manner.

Vaccination may not be a practical tool in controlling HPAI in an endemic environment such as Indonesia, considering the enormous organizational, human, material, and financial resources required for sustained country-wide application. For this strategy to be effective, it must include an adequate supply of good-quality vaccine and veterinary services accompanied by a clearly defined approach and exit mechanism.

In terms of restructuring the poultry sector, FAO recommends that the restructuring be based on farm and market biosecurity measures. It is therefore crucial to do a careful review of the conditions and the impact of restructuring on the economic situation and livelihoods of poultry producers—again, with particular emphasis on the poorer backyard poultry producers.

It is clear that control strategies work if used properly, but there are underlying constraints that limit their effective use. For prevention and control programs to be successful and effective, both technical and financial support are needed from international and local development institutions in the following:

- strengthening surveillance, detection, and early reporting;
- providing strategic vaccination with good-quality controlled vaccines;

- investing in veterinary diagnostic laboratory capacity, including training and deployment of veterinary and human epidemiologists and health workers;
- strengthening capacities on outbreak response and reporting systems;
- improving biosecurity measures both on farms and in marketplaces; and
- improving education and communication campaigns related to HPAI.

These measures involve considerable economic costs as well as behavioral changes (in terms of adoption of these measures), so identifying the most cost-effective and socially equitable control measure could be a large contribution in the efforts to prevent highly pathogenic avian influenza or reduce the its risk.

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