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HPAI PRO-POOR HPAI RISK REDUCTION

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

Marites M. Tiongco

Africa/Indonesia Team Working Paper No. 6

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Preface

Since its re-emergence, HPAI H5N1 has attracted considerable public and media attention because the viruses involved have been shown to be capable of producing fatal disease in humans. While there is fear that the virus may mutate into a strain capable of sustained human-to-human transmission, the greatest impact to date has been on the highly diverse poultry industries in affected countries. In response to this, HPAI control measures have so far focused on implementing prevention and eradication measures in poultry populations, with more than 175 million birds culled in Southeast Asia alone.

Until now, significantly less emphasis has been placed on assessing the efficacy of risk reduction measures, including their effects on the livelihoods of smallholder farmers and their families. In order to improve local and global capacity for evidence-based decision making on the control of HPAI (and other diseases with epidemic potential), which inevitably has major social and economic impacts, the UK Department for International Development (DFID) has agreed to fund a collaborative, multidisciplinary HPAI research project for Southeast Asia and Africa.

The specific purpose of the project is to aid decision makers in developing evidence-based, pro-poor HPAI control measures at national and international levels. These control measures should not only be cost-effective and efficient in reducing disease risk, but also protect and enhance livelihoods, particularly those of smallholder producers in developing countries, who are and will remain the majority of livestock producers in these countries for some time to come.

This report is the first step of the project which has compiled and assessed the current state of knowledge of poultry systems and their place in the larger economy of the study country, the current HPAI situation and its evolution, and institutional experiences with its control (or, where it has not taken place, contingency places should it arise). This information has been written by a multidisciplinary national team in the study country highlighting the current knowledge and knowledge gaps related to the interface of poultry, HPAI, and institutional response as a crucial first step to the analytical research outputs to be generated in the course of this project. In the process of writing the background paper a variety of country-specific data and information sources on poultry systems, HPAI, and mitigation/control efforts, including published and grey literature, national statistics, journal articles, and reports from other research efforts that are ongoing in the country have been complied into a data base located at the project web site http://www.hpai-research.net/index.html.

Author

Marites Tiongco, Postdoctoral Fellow, Markets, Trade and Institutions Division, International Food Policy Research Institute

Disclaimer

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The present paper synthesizes the five background papers of a joint IFPRI-ILRI research project titled HPAI Pro-poor Risk Reduction. The background papers were led by national institutions in Ghana, Ethiopia, Indonesia, Kenya, and Nigeria. Intellectual ownership of insights specific to the countries covered by the background papers belongs to the authors of the country background papers, who nevertheless should not be held responsible for any errors of interpretation on our part.

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More information

For more information about the project please refer to www.hpai-research.net.

List of Contributions by Country Collaborators

Region Report No. 1: Overview and Background Paper on Ethiopia's Poultry Sector: Relevance for HPAI Research in Ethiopia

Dawit Alemu, Socioeconomics Research Program, Ethiopian Institute for Agricultural Research (EIAR), P.O.Box 2003, Addis Ababa, Ethiopia
Setotaw Ferede, Socioeconomics Research Program, Ethiopian Institute for Agricultural Research (EIAR), P.O.Box 2003, Addis Ababa, Ethiopia
Tamirat Degefo, Socioeconomics Research Program, Ethiopian Institute for Agricultural Research (EIAR), P.O.Box 2003, Addis Ababa, Ethiopia
Serge Nzietchueng, International Livestock Research Institute, Nairobi, Kenya.
Devesh Roy, Markets, Trade, and Institutions Division, International Food Policy Research Institute, Washington, D.C.

Region Report No. 2: Pro-Poor Risk Reduction Strategies: Ghana Background Review Paper

K. G. Aning, Professor, University of Ghana, P.O. Box LG 74, Legon, Ghana
Paa Kobina Turkson *BVM, MSc, PhD., Professor and Veterinary Epidemiologist, Animal Science Department, School of Agriculture, University of Cape Coast, Cape Coast, Ghana.*
S. Asuming-Brempong, Agricultural Economist, University of Ghana, P.O. Box LG 74, Legon, Ghana

Region Report No. 3: Overview on poultry sector and HPAI situation for Indonesia with special emphasis on the Island of Java

Bambang Sumiarto, Faculty for Veterinary Medicine, Gadjah Mada University, Yogyakarta, Indonesia
Bustanul Arifin, InterCAFE (International Center for Applied Finance and Economics), Bogor Agricultural University, Jl. Pajajaran, Bogor 16151, Indonesia

Region Report No. 4: An Overview of the Poultry Sector and Status of HPAI in Kenya

John M. Omiti, Ph.D., Senior Policy Analyst 8 Head, Productive Sector Division, The Kenya Institute for Public Policy Research and Analysis (KIPPRA), Bishops Garden Towers, 2nd Floor, Bishops Road, P.O, Box 56445-00200, Nairobi, Kenya
Sam Okuthe, Kenya Agricultural Research Institute (KARI), Kaptagad Rd., Loresho Nairobi Kenya, P.O. Box 57811 City Square, 00200 , Nairobi, Kenya

Region Report No. 5: Pro-Poor Risk Reduction Strategies: Background to the Study in Nigeria Paper

Timothy Uzochukwu Obi, Professor, Faculty of Veterinary Medicine, University of Ibadan, Ibadan, Nigeria
Adewale Olubukola Oparinde, Queens' College, Cambridge University, UK, CB 9ET
Garba Ahmed Maina, Ph.D., Ministry of Agriculture, P.O. Box 983 Gusau, Zampara

1. Introduction

The emergence of Highly Pathogenic Avian Influenza (HPAI) and the threat of a global human pandemic have been issues of great concern to the international community in recent years. The problem is compounded with the uncertainty regarding the timing, extent, spread mechanism, and severity of HPAI, and the risk of human infection.

The global response has been extensive, with billions of dollars pledged for efforts to control and prevent the influenza. Even though HPAI is a global phenomenon, developing countries in Africa and Asia have had the most difficulty containing the disease. Between 2003 and 2008, 47 countries had reported HPAI in their domestic poultry. Those currently considered endemic are Egypt, Indonesia and Nigeria, while other countries such as Bangladesh, China, Thailand and Vietnam have had repeated outbreaks. As of June 2008, fifteen countries have reported human cases, and all except one of those have reported human fatalities.

In addition to actual outbreaks, control and prevention strategies have significant associated economic and social costs, including the direct costs of standard disease control measures – such as compensation, vaccination, eradication and biosecurity – as well as the indirect costs of building institutions and mechanisms to support those control measures. Significant indirect costs also stem from wide-spread market shocks, which place a heavy burden not only on poultry producers of all sizes, input suppliers, and others along the poultry value chain, but also on consumers. Therefore, when designing effective, cost-efficient strategies to control and prevent the disease, both direct and indirect costs must be weighed against direct and indirect benefits.

However, in many of the countries affected with the disease, the prevention and control measures that have been implemented have not taken into account the costs and benefits, and cost effectiveness of different strategies. The effectiveness and efficiency of the control and prevention strategies may significantly vary between production systems in terms of flock size, level of biosecurity, marketing channels, and type of birds reared but most of the strategies have not taken into account the heterogeneity of poultry producers in developing countries. Moreover, less emphasis has been placed on the assessment of the effects of these 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 in adopting a proposed strategy. The United Kingdom's Department for International Development (DFID) has taken the challenge to close this research gap through the **Pro-Poor HPAI Risk Reduction Strategies Project.**

The objectives of this project are to:

- Identify the pathways by which HPAI can spread to poultry in each study country, and what is the likelihood that it will spread by each identified pathway.
- Identify and quantify socio-economic, spatial and temporal distributional impacts of potential and actual HPAI outbreaks;
- Identify critical control points for mitigation of HPAI risk in each study countries, and the economic costs and benefits associated with each strategy at each identified control point;

- Identify how the costs and benefits of various control and prevention strategies distributed among different segments of the population in each study country, with particular emphasis on the poor;
- Identify which cost-effective, efficient and equitable control and prevention strategies or biosecurity measures are most likely to be implemented (i.e. adopted) by the poor in each study country;
- Identify the institutions and incentive mechanisms that would enable or impede adoption of control and prevention strategies that are both effective and pro-poor in each study country, and how can these be facilitated by interaction with international institutions;
- Compare similarities and differences from national and regional experiences so as to derive national and international lessons for efficient, effective and equitable HPAI prevention and control;
- Identify the type of decision and communication processes that need to be in place to ensure that research findings are incorporated into the policies and plans for HPAI control and prevention;
- Compare similarities and differences among various control and prevention strategies, and institutions and incentive mechanisms for different countries depending on their epidemiological and economic situation.

This project is being implemented in several Southeast Asian (Cambodia, Indonesia, Thailand, and Vietnam) and African countries (Ghana and Nigeria) that have experienced HPAI outbreaks including Ethiopia and Kenya where no HPAI outbreak has occurred yet. The International Food Policy Research Institute (IFPRI) and the International Livestock Research Institute (ILRI) will address HPAI in the African countries and Indonesia.

In order to better understand the poultry structure and current disease situation in Ethiopia, Ghana, Kenya, Indonesia, and Nigeria, IFPRI and ILRI have commissioned national partners in each of these countries to write background papers. The background paper in each country serves as baseline information to establish a database that will be used in generating analytical research outputs of the project. These papers contain all the existing information and data that the authors compiled and reviewed from a variety of sources comprising published and grey literature, national statistics offices, national surveys such as the LSMS, DHS, and other household surveys, and other research efforts ongoing in each of the study countries. Such information include poultry production systems, current disease situation and its development, and institutions involved in emergency response preparedness or implementation of prevention and control measures, and so on. The background papers in each of the study countries also identified a number of gaps (and strengths) in the current status of knowledge and infrastructure, and relevant information that were not readily available and missing.

A synthesis of the five background papers presented here aim at providing an inventory of data and information from these five countries. The succeeding sections provide a brief description of: (i) the importance of the poultry sector in the economy and on rural livelihoods; (ii) the structure of the poultry sector and associated level of biosecurity; (iii) threats and incidences of HPAI, policies implemented with the occurrence of outbreaks, and institutional response capacity; (v) the current knowledge regarding spread and impact of HPAI on the poor, and identified constraints/challenges hindering effective control and mitigation of the disease; and (vi) identified research gaps in each of the study countries.

2. Overview of the Poultry Sector and Its Importance in the National Economy and Rural Livelihoods

Over the last four decades there has been rapid growth in livestock production and a rapid change in how animal products are produced, processed, consumed and marketed. Growth in livestock production in both developed and developing countries has been led by poultry (Narrod et al. forthcoming). From the 1990s to 2005, consumption of poultry meat in developing countries increased by 35 million tonnes, which has been most evident in East and Southeast Asia and in Latin America, particularly in China and Brazil (Table 1). The share of the world's poultry meat consumed in developing countries increased from 43 to 54 percent over the period 1990-2005, which accounted for 36 percent of the large net increase in meat consumption in developing countries over this period. Further, the proportion of the world's poultry meat produced in developing countries rose from 42 to 57 percent. It is estimated that production and consumption of poultry meat in developing countries will increase by 3.6 percent and 3.5 percent per year, respectively, from 2005 to 2030 brought about by rising incomes, diversification of diets and expanding markets, particularly in Brazil, China and India.[1]

Table 2 shows that in fact pork and poultry are the prominent contributors of agricultural growth in developing countries. If the poor fail to remain active in these sectors, they would have missed a tremendous opportunity to improve their livelihoods. Small-scale producers depend on poultry for their livelihoods, food security and nutritional needs. Often poultry constitute a quick and high-return investment opportunity for breaking out of the poverty trap.

Poultry has been recognized as one of the new income generating activities especially for women who are increasingly involved in the sector (The World Hunger Project, 2005). A number of donor agencies have implemented projects so that both women and children will benefit directly in terms of livelihoods and access to micronutrients. Currently, there are a number of projects in the Rift Valley region to try to encourage livestock production as a nutritional intervention. If HPAI were to spread further into these regions, it would affect a significant portion of the rural poor, women, and children. The exact number of people involved in poultry production is unknown; however women do the management of poultry in many of these households. A survey in four African countries (Ethiopia, The Gambia, Tanzania and Zimbabwe) showed that women dominate most activities except for shelter construction and marketing (Kitalyi, 1998). In Africa, a woman typically has a flock of fewer than ten chickens and the poultry tends to be managed within homes. In rural areas, this is

[1] Projections to 2030 are from the International Food Policy Research Institute's (IFPRI) International Model for Policy Analysis of Agricultural Commodities and Trade (IMPACT) model projections, October 2007. The IMPACT model, developed by Rosegrant *et al*. (2002), offers a methodology for projecting global and regional food demand, supply, trade, prices, income and population to 2020 and 2030.

the main resource where women farmers have access to benefits and often use the incomes from poultry to supplement their livelihoods in terms of school fees and for incomes to access cheaper food.

In several developing countries affected by HPAI it is the smallholders who bear the bulk 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 nuance 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 make changes in 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 (including women involved in the sector) to adopt such measures that might displace them.

Table 1. Production and per capita consumption of poultry meat by region, 1990-1992 and 2003-2005

Region	Poultry meat production					Poultry meat consumption				
	1990-1992		2003-2005		2030 (projected)	1990-1992		2003-2005		2030 (projected)
	(million tonnes)	(% of world production)	(million tonnes)	(% of world production)	(% of world production)	(million tonnes)	(% of world consumption)	(million tonnes)	(% of world consumption)	(% of world consumption)
China	4.5	10	14.2	18	23	3.3	10	10.3	16	26
India	0.4	1	1.8	2	4	0.4	1	1.7	3	3
Other East Asia	1.8	4	1.9	2	0	0.4	1	0.5	1	1
Other South Asia	0.8	2	1.8	2	1	0.3	1	0.6	1	2
Southeast Asia	1.2	3	5.2	6	7	2.1	6	4.2	6	7
Latin America	5.9	14	15.9	20	21	5.4	16	13.3	20	17
of which Brazil	2.7	6	8.5	11	10	2.3	7	6.1	9	7
West Asia and North Africa	1.5	3	2.9	4	6	2.2	7	4.4	7	7
Sub-Saharan Africa	1.3	3	1.8	2	2	0.7	2	1.2	2	4
Developing World	18.2	42	45.8	57	65	14.3	43	35.4	54	67
Developed World	25.2	58	35.1	43	35	18.8	57	29.9	46	33
World	43.5	100	80.9	100	100	33.1	100	65.3	100	100

Note: Projections to 2030 are from IFPRI's International Model for Policy Analysis of Agricultural Commodities and Trade (IMPACT) model projections, October 2007.
Source: Narrod et al forthcoming.

Table 2. Production growth rates in developing countries, 1975–2005

	% *per annum* (by volume)
Cereals	2.2
Fruit	3.9
Vegetables	5.1
Fish	1.6
Milk	4.0
Pork	6.0
Poultry	7.0

Note: "Fish" includes marine and freshwater fishes; "Poultry" includes chicken, duck and turkey meat.
Source: calculated from data obtained from FAOSTAT, accessed on March 2007.

Economic contributions of the poultry sector

Poultry production in the study countries is relatively small compared to the rest of the world. Table 1 indicates that between 2003 and 2005, poultry production from Sub-Saharan Africa made up only 2% of total world production. Despite sluggish poultry production growth relative to the rest of the world, FAO statistics suggest that all five study countries have experienced increasing growth in production over the period 2000-2005 (Table 3). Indonesia, having experienced the highest among the countries, has enjoyed approximately 9% annual growth rate in poultry production over the same period (Table 3). The numbers on poultry production in Table 3 are probably underestimated as there are a number of backyard poultry operations in all countries that may not have been officially recorded. A similar trend can be observed in egg production but at slower growth rates than that of poultry. A more detailed description of the production trends for each of the study countries are presented below.

Table 3. Production of live chicken and eggs in the study countries, 2000 – 2005

Live chicken (1000 tonnes)

	2000	2001	2002	2003	2004	2005	Growth Rate (2000 – 2005)
Ethiopia	37.73	49.84	54.06	50.16	47.1	52	6.63
Ghana	19.57	21	23.44	25.58	28.31	28.79	8.03
Indonesia	921.33	1036.15	1240.31	1278.89	1362.12	1423.63	9.09
Kenya	14.82	22.37	20.8	24.44	24.12	20.44	6.64
Nigeria	160.01	183.5	190.12	201.09	211.01	211.07	5.70

Eggs (1000 tonnes)

	2000	2001	2002	2003	2004	2005	Growth Rate (2000 – 2005)
Ethiopia	28.6	37.8	39.2	37.1	36.6	36.6	6.36
Ghana	21.7	22.3	23.3	24.4	25.2	25.2	3.81
Indonesia	642	693	776.1	788.6	934.1	856.6	7.48
Kenya	59.5	60.7	60.7	60.7	60.7	60.7	0.50
Nigeria	400	440	450	460	-	-	4.77*

(*growth rate for 2000 – 2003)
Source: calculated from data obtained from FAOSTAT, accessed on June 2007

Ethiopia

Relative to other types of livestock, poultry represents a fairly small share of total livestock output. Per capita consumption of chicken meat and eggs have exhibited a slightly downward trend between 2002 and 2005 (from 0.72 in 2002 down to 0.64 in 2005) which could be due to several reasons such as rapid increase in population, relatively stagnant per capita incomes, and continuously low productivity in the poultry sector (Table 3). Production of poultry and poultry products has increased on average over the period 2000-2005. Tables 3 suggests that although there has been a net increase, chicken production and consumption has fluctuated from year to year with a noteworthy plummet from 2003 to 2004. Relative to the five countries, consumption of poultry and eggs per capita appears to be lowest in Ethiopia.

While many of the birds produced by small-scale commercial farms (raising exotic breed) are eventually sold in local open markets or to local restaurants, their primary product is eggs and not meat. This is driven by consumers' demand and preference for indigenous chicken meat. Consumers still prefer the taste and texture of the meat of indigenous breeds. In the case of eggs, consumers prefer large, brown, and regular-shaped eggs that exotic birds produce, but consumers still prefer the taste and deep yellow yolk color of indigenous birds' eggs.

Consumer preferences are also influenced by some socio-cultural factors. For example, when purchasing live birds, consumers prefer brown birds and are willing to pay a higher

price for those types of birds than white birds (exotic). Black birds are far less preferred as they are believed to bring bad fortune, while white birds are thought to be disease-transmitting agents affecting humans. Consumers also consider the type of comb, with an expressed preference for double-combed birds. As a result of these preferences, exotic birds such as the single-combed White Leghorn are less desired by consumers (Aklilu 2007).

Consumers also prefer broilers because the meat is lean and tender compared to old pullets. Experienced buyers, especially traders, estimate the age of chicken by looking at the roughness of the bird's legs: birds with rough legs are considered old and fetch lower prices, while birds with feathered necks are preferred over those with naked necks (Aklilu 2007).

Ghana

In 2005, livestock and poultry, together contributed 7% of the national agricultural GDP of 40.6% (Aning 2008). Ghana has experienced relatively high poultry production growth rates between 2000 and 2005. The actual level of production remains quite low (Tables 3). As it appears, Ghana imports most of its poultry in order to meet domestic demand.

There is no information on the number of people employed in the poultry sector. Village poultry rearing is not the main occupation of rural farmers, although it provides substantial support to rural households (Aboe *et al.,* 2006). Based on the Ghana Living Standard Survey (GLSS) in 2005, there are about 32% of all sample households raising poultry. The largest proportion of poultry producers is found in the Upper West region (74%), followed by Northern region (61%), and then the Volta region (45%).

Indonesia

Of the five countries, Indonesia has the highest poultry production both in terms of quantity produced and growth rate.. Production of poultry and eggs increased at an annual rate of 9% and 7.5%, respectively. Interestingly, live chicken and egg production has been increasing despite the adverse effect of AI outbreaks that hit the country since 2003. Production for broilers and layers are concentrated in Java Island and North Sumatra where the big cities are located.

Kenya

Kenya is generally self-sufficient in eggs and poultry meat in terms of production. According to Omiti and Okuthe (2008), 66% of Kenyan households keep at least one type of livestock, of which 67% raise chicken (78% keep 10 or fewer birds). Poultry is a major source of animal proteins and is generally part of the Kenyan household diet. As shown in Table 3, chicken production has increased between 2000 and 2003, but started to decline in 2004-2005. Chicken prices vary by breed (indigenous vs. commercial) and market outlet. Chicken egg prices also vary with the market. A tray of 30 eggs retails at between Ksh 130 and 150 in Nairobi, which translates to Ksh 4.3 – 5 per egg.

Nigeria

Data on poultry production for Nigeria are based on estimates and projections from the 1990 livestock census. FAO estimates presented in Table 3 suggest that over the period 2000 to 2005, chicken production increased by about 5.7%. Chicken meat consumption per capita

was relatively stable since 2000 with an average growth of 2.64% for poultry and 2.13% for eggs.

The Central Bank of Nigeria (Abiola 2003) estimated poultry meat production using NBS and FAO data and they came up with an estimate of 107,000 tonnes in 2002. The Federal Government of Nigeria (FGN, 2007) report suggested that the country produced 4 million tons (carcass-weight equivalent) of poultry meat in 2004-2005 representing about 17% of the total meat consumption during this period. Adene and Oguntade (2006) reported that Nigeria has the capacity to produce 40,740 tonnes of dressed culled layers, 96,980 tonnes of dressed broilers, and 8.2 billion eggs annually. They based their estimates on the assumption of resource optimal utilization, and used pre-HPAI outbreak data on grandparent stock import (79,000) and parent stock (1,632,400) to arrive at approximate annual production capacity. However, this information does not generally include the production in the rural poultry sector where majority of the DOC inputs are local breeds.

As exemplified above, it is not surprising that there are inconsistencies and discrepancies in the figures of poultry production in the study countries given that they come from different sources and that each source used a different definition and classification of the poultry operations.

Trade flows

On the global scene, trade in poultry meat is increasing and is projected to increase at a faster rate than production and consumption (OECD–FAO 2007). Among the poultry products, broiler seems to dominate the international poultry trade. Table 4 shows the top five broiler importing and exporting countries or regions for 2005. In terms of broiler imports, the Russian Federation dominates, followed by Japan and the European Union-25. Brazil and the USA dominate in terms of broiler exports and are major exporters to Ghana and Indonesia. China is emerging as an active broiler exporter with some of its exports flowing into Nigeria.

Among the five study countries, Ghana has the highest importance of live poultry as a traded product. Ghana mainly imports meat from countries that are AI free and exports some eggs. The top three importers of poultry meat into Ghana are the USA, Brazil, and the EU (Table 6). There have been recent increases in poultry meat imports, particularly for chicken thighs, which has substantially increased (more than four times) between 2000 and 2005 (Figure 3.3 in Aning et al. 2008, Annex II). Chicken thighs seem to be preferred because of the ease of use in preparing many Ghanaian dishes. On the whole, chicken importation has risen consistently since 1995 with chicken thighs dominating and rising to almost 30,000 tons in 2001 and 2004. Poultry imports over the period 2000-2004 have increased by about 1200%.

The tariff imposed on imported food items, including poultry products, has not changed since the 1990s. It has remained at 20% (Table 7). There have been petitions from some identifiable bodies (such as the Ghana Poultry Farmers Association) to raise the tariff for poultry products to improve the competitiveness of local production. These attempts have

failed due to the government's commitment to existing multilateral and bilateral arrangements.

Kenya does not import or export any chicken meat. However, other poultry products are traded. Day old chicks are the major exports while hatching eggs are the major imports. A substantial number of day old chicks are imported as well. Kenyan poultry products, especially hatching eggs and day old chicks, are exported to the neighboring countries – Uganda, Tanzania and Ethiopia. None of these countries has so far reported any incidence of HPAI. In February 2006, there were rumors of avian flu in Ethiopia. Subsequent laboratory tests however did not reveal any case. Kenya imports poultry breeding stock (parent birds, fertilized eggs and day old chicks) mainly from Mauritius, Holland, Egypt, India and South Africa. Commercial turkeys are mainly imported from the United Kingdom and the USA. Egypt reported its first case of HPAI in 2003 while both Holland and India reported theirs in 2006. So far, only Holland has managed to contain the disease; Egypt and India are still struggling with the disease.

In Nigeria, most of the inputs in poultry production such as DOCs, equipment, feed concentrates and processed poultry products are imported from Asia, Europe and the USA. Imports of these products have been significantly increasing until the FGN imposed a import ban of these poultry products in 2002 (Obi et al 2008, Annex V). Also in 2002, the government sought to protect domestic industries against unfair competition from imports and dumping by increasing tariff rates for certain livestock products such as turkey parts and dressed chicken from 25% to 75%, but tariff for DOCs remained at 5% to encourage local production (Table 7).

In 2003, Nigeria imported live birds (poultry input) from the United Kingdom and EU countries, Hong Kong and other Asia countries where HPAI outbreaks have occurred. A total of 415,578 kg of poultry products (live birds, meat and eggs) worth US$43.6 million (using N127 per 1US$) was imported in 2003, which is a little bit higher than the value of imported live birds in 2006, valued at US$43 million of live birds (Table 5). Nigeria also imports products of animal origin from its neighboring countries like Ghana and Cameroon.

In the case of exports, data from COMTRADE show no exports on poultry products in 2006 but trade statistics from NBS indicate exports of skins and parts of birds (excluding feathers for stuffing; down) worth N15, 331,800 in 2006 (Obi et al. 2008, Annex V).

In Ethiopia, trade in poultry and poultry products is also concentrated to importation of live birds and DOCs. Large-scale intensive poultry farms and multiplication centers are mainly dependent on the import of day old chicks mostly coming from the EU, Saudi Arabia, Egypt, and its neighboring African countries (such as Kenya, Sudan and Djibouti). Since 2006, Ethiopia has banned importation of poultry products from Egypt, the UK, and Germany due to the incidence of HPAI in these countries. However, following the declaration of an outbreak of HPAI in Egypt, Germany and the UK in early 2006, Ethiopia banned imports of day-old chicks from these three countries and only allowed imports from exporting countries free of HPAI.

The series of outbreaks of HPAI in Indonesia reduced the export value of live poultry between 2004 and 2006 (Bogor Agricultural University 2007). The average annual export volume of poultry in 2001-2003 was 228,000 tonnes, which then declined to only 60 tonnes in 2005. Exports for live birds in 2006 were valued at $33,935 (Table 5). Export of DOC (day-old chicken) was stopped in 2004 and 2005 because there was no demand for Indonesian DOCs from neighboring countries. Similarly, the export value of chicken meat from Indonesia also declined by 88.2%. Indonesia's imports of live birds have also decreased over the period 2003-2006 (Table 6).

Table 4. Broiler imports and exports: top five countries or regions in 2005

Country/region	Imports	Exports	Production	Share of Production
	(1 000 tonnes)			(%)
Russian Federation	1204		1346	89
China	907		10102	9
Saudi Arabia	451		545	83
Japan	419		1 339	31
Mexico	357		2 437	15
Brazil		2762	8507	32
United States of America		2480	15945	16
European Union-27		2123	9319	23
China		296	10102	3
Argentina		111	1010	11

Source: FAOSTAT accessed 23 October 2007.

Table 5. Live poultry trade value in 2006

		Exports (US$)	Imports (US$)	Net Trade (US$)
Ethiopia	Live	-	333	-333
	Processed	-	43,163	-43,163
Ghana	Live	-	3,745,157	-3,745,157
	Processed	-	16,204	-16,204
Indonesia	Live	33,935	395,402	-361,467
	Processed	37,415,330	2,326,334	35,088,996
Kenya	Live	-	128,631	-128,631
	Processed	18,145	-	18,145
Nigeria*	Live	-	42,616,070	-42,616,070
	Processed	-	149,022	-149,022

Note: * Data for Nigeria is from 2003

Source: UN Comtrade Database

Table 6: Value of imports of live birds to the study countries

	2003			2006		
	From Asia	From Eastern Europe	From European Union	From Asia	From Eastern Europe	From European Union
		(US $1000)			(US $1000)	
Indonesia	1,678	22	2,723	1,277		622
Ethiopia			124	25		
Kenya			107		11	129
Ghana				50	34	3118
Nigeria	31		42,527			

Source: UN Comtrade Database

Table 7. Tariff rates and trade policies

Indicators	Ethiopia	Ghana	Indonesia	Kenya	Nigeria
Trade policies related to poultry					
Changes in trade policies after Avian Flu	No significant changes	No significant changes	Ban on import of poultry carcass and Mechanically Deboned Meat (MDM) was lifted in 2006. MDM must however come from a Modifiable Avian Influenza disease free country and originate from a farm that is registered under control of authorized animal health officials from the originating country.	Restriction of egg importation increased the cost of eggs in Kenya.	No significant changes
Import/Export potential			Before 2003, Indonesia's major export destinations were Japan and Malaysia		
Import Tariff levels	-	20% plus other taxes	Duty free for live poultry and 5% for chilled	Duty free for live poultry and 15% for chilled or	75% for dressed chicken; 5%

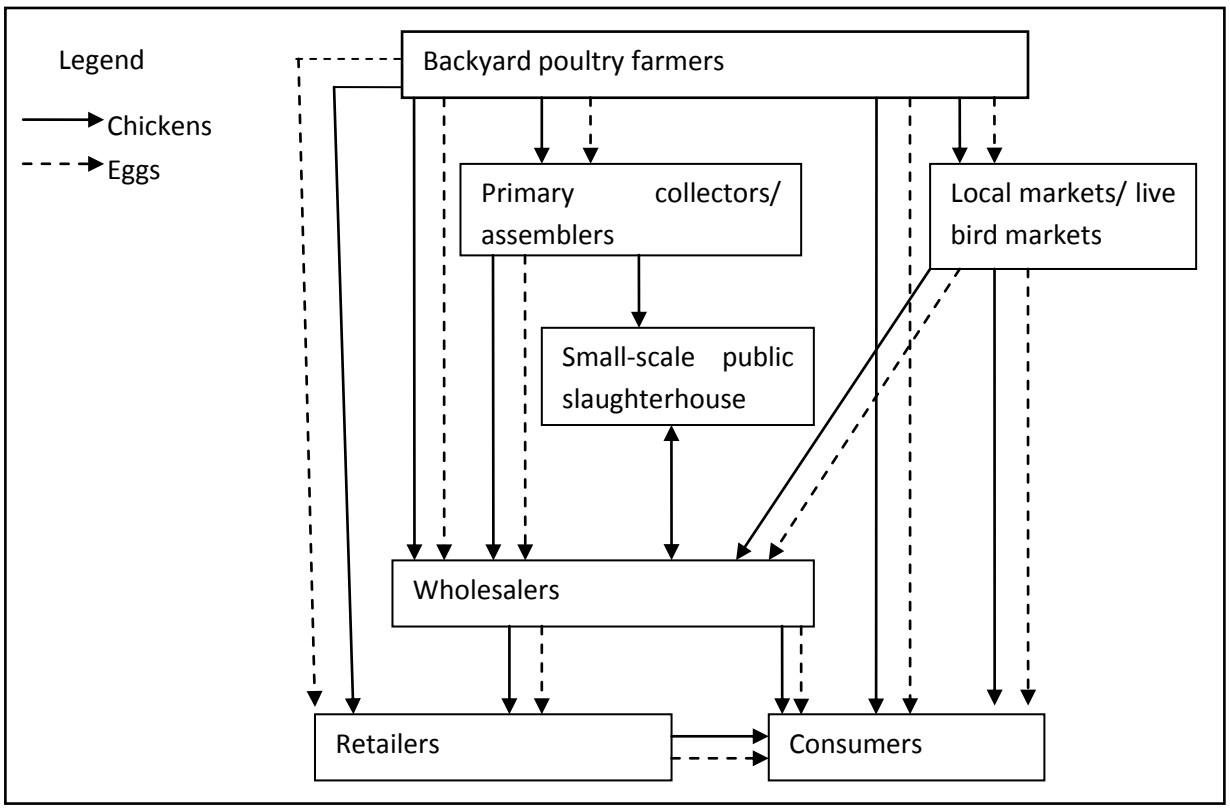
	or frozen meat products	frozen meat products	for DOCs

Sources: Alemu et al. 2008; Aning et al. 2008; Sumiarto and Arifin 2008; Omiti and Okuthe 2008; Obi et al. 2008.

Poultry marketing system

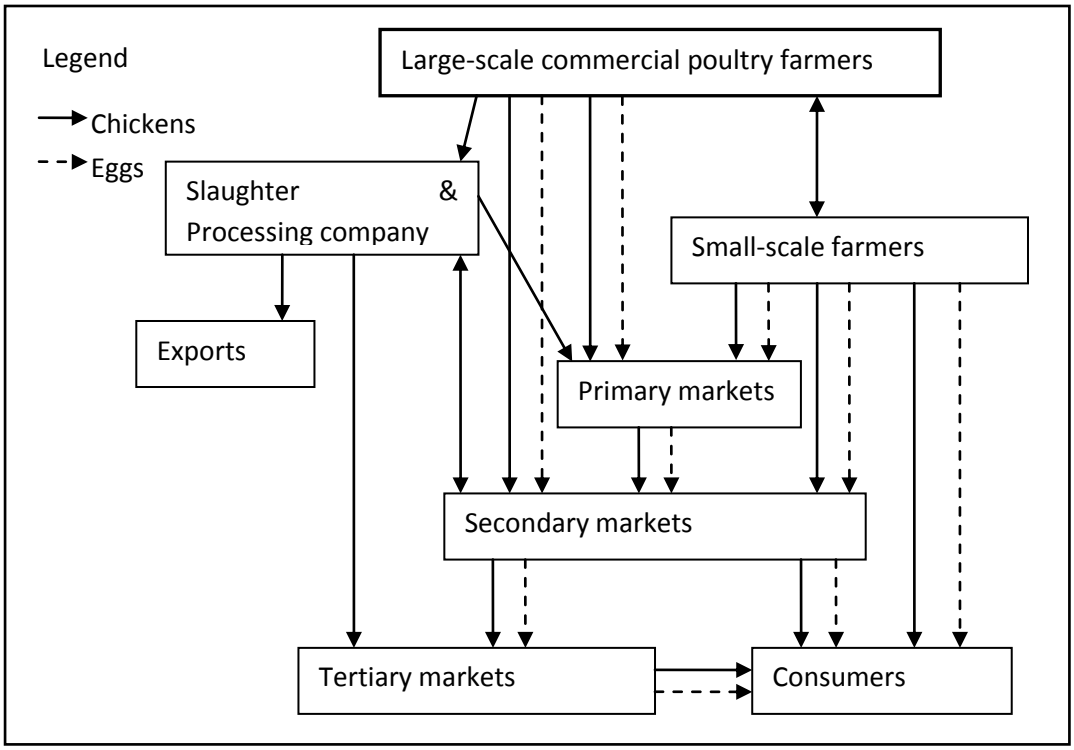
In most developing countries, the majority of poultry and eggs are sold through the wet markets either as live birds or slaughtered because consumers prefer to buy fresh meat. The wet markets are the major market outlets of small-scale producers and traders. Even the large-scale, vertically integrated producers sell to wet markets aside from the major market segments that they supply—hotels, restaurants, institutions, supermarkets, and company's selling outlets (see Figure 1). The marketing system in the five study countries can be characterized as fragmented and involves small-scale/backyard operations as shown in Figure 2. 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 scale of production, most farmers sell live chicken on local markets, with most slaughter taking place in the market or consumers' homes. A more detailed description of the poultry marketing system in each of the study countries are discussed below.

Figure 1. Market channels for chicken and eggs produced by backyard poultry farmers



Note: The link between backyard poultry farms and consumers is farm-gate sales to neighbors.
Sources: Alemu et al. 2008; Aning et al. 2008; Sumiarto and Arifin 2008; Omiti and Okuthe 2008; Obi et al. 2008.

Figure 2. Market channels for chicken and eggs from large-scale commercial poultry farms



Note: Primary markets include supermarkets, hotels, restaurants (could be owned by the owners of large-scale commercial farms); secondary markets are city markets, shops, small restaurants, and wholesalers and traders; tertiary markets are local wet markets, retailers, local butcheries, and live bird markets.
Sources: Alemu et al. 2008; Aning et al. 2008; Sumiarto and Arifin 2008; Omiti and Okuthe 2008; Obi et al. 2008.

Ethiopia

Poultry marketing in Ethiopia are both formal and informal. Formal marketing exists in urban and peri-urban areas. The majority of the products sold within the formal sector come from large commercial poultry farms (such as ELFORA and Genesis) although there are a few indigenous frozen chickens found in some supermarkets in Addis Ababa (Demeke 2007). Some supermarkets buy live poultry and arrange for slaughter in government (public) or private abattoirs.

Informal marketing of poultry products —both meat and eggs—are very common in wet markets and open markets such as on road sides. The bulk of poultry marketing involves the producers and intermediaries (assemblers and traders) as well as retailers. Women dominate the producer-seller group while men dominate the intermediaries and traders group. Traders buy chicken and eggs from backyard farms and sell them to assemblers and wholesalers. Retailers prefer to obtain supplies directly from poultry farms and from wholesalers; those retailers who are concerned about the quality and continuity of supply would obtain live chickens from large-scale commercial and semi-commercial poultry farms.

Farmers who prefer not to sell their birds and eggs on farm would take their produce to local or primary markets that are usually concentrated in the rural areas.

The market for poultry products is closely linked to the major social and religious festivals in Ethiopia. Peak consumption in both subsistence and commercial systems are typically recorded during the Ethiopian new year (September), Ethiopian Christmas (January), Ethiopian Epiphany (January), Ethiopian Easter (April), and St. Mary's day (August). Periods of low consumption coincide with the Lent fasting period which lasts for 55 days between February and March, and during the shorter pre-Christmas fasting period. In addition to the fasting periods, most strict orthodox Christian households, especially in the rural areas, abstain from eating animal products on Wednesdays and Fridays (except during the 55 days following Easter). Necessarily, poultry prices throughout the country respond to these shifts in demand (Aklilu 2007).[2]

The market for poultry products is also linked to the geographic proximity of producers to market towns and cities. Addis Ababa, with its population of some 5 million people and network of high-quality roads leading into the city from outlying areas, serves as the key market for the rural and peri-urban areas surrounding the city.

Table 8. Market structure of poultry in the five countries

Indicators	Ethiopia	Ghana	Indonesia	Kenya	Nigeria
Poultry marketing					
Industrial /integrated	Commercial	Commercial	Commercial	Commercial	Commercial
Large-scale commercial	Comm/Traditional	Comm/Traditional	Traditional	Commercial	Commercial
Small-scale commercial	Supermarket	Traditional/ Live bird markets	Traditional/ Live bird markets	Comm/Traditional Trad/Household	Live bird markets /
Backyard/village	Live bird markets/ Household	Live bird markets/ Household	Live bird markets/ Household		Live bird markets /Household
Poultry price changes after Avian flu	Dropped by approximately 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 high as 90%
Vertical integration	Moderate	Moderate	Weak	Fairly Strong	Weak

[2] Note, however, that consumption and prices are not closely linked to Muslim holidays, possibly owing to different celebration and consumption traditions during these events.

Geographical concentration of Commercial Poultry Producers	In and around capital city (Addis Ababa) and urban areas	Three major regions located in the South (Greater Accra, Ashanti and Brong-Ahafo)	Island of Java and the Yogyakarta Special Territory	Capital city and urban areas	Most are located in Oyo State; others in Ondo, Kaduna and Ogun State

Sources: Alemu et al. 2008; Aning et al. 2008; Sumiarto and Arifin 2008; Omiti and Okuthe 2008; Obi et al. 2008.

Ghana

Most of the backyard poultry farmers (free-range) sell their produce from their farms. Traders come to the farm to buy chicken and eggs directly from farmers and sell them at wet markets in rural areas. They also sell dressed chicken (whole) to household consumers and caterers. Poultry sold at wet markets in urban areas mainly come from commercial and semi-commercial poultry farms.

Some small-scale and most medium and large scale broiler producers process their birds for sale as frozen whole birds and sell them to traders, caterers, and household consumers. There are producers who their own retail shops as their market outlet. There are a few processors emerging in the market that sell processed products such as nuggets, sausages, frankfurters and marinated chicken (Aning, 2006), These poultry processing companies have established a cold chain infrastructure to market their processed poultry products generally in urban areas but some are sold in the traditional distribution channels (traditional markets).

Meat importers also play a major role in the poultry marketing chain. They act as wholesalers of imported fresh and frozen or processed poultry products and distribute them in bulk to retailers. They also sell local chicken to retailers.

Indonesia

The markets for commercial large-scale farms (broilers and layers) are well organized. They have their own direct outlets to consumers and retailers. Smaller scale producers and backyard poultry producers depend mostly on traders who collect from different producers. According to Sumiarto and Arifin (2008), Indonesia has more than 13,000 live bird markets that operate daily, where 80% of traded poultry are sold live and 20% slaughtered. Live bird markets usually do not operate on regular schedules. They may follow specific religious calendar, or open every 5^{th} day so local traders move around from one market to the other, depending on which ones are open for trading in a particular district. Local traders (or collectors) either distribute live birds directly to consumers or to slaughter houses for slaughtering and dressing of poultry. From slaughterhouses, there are traders who distribute carcasses to consumers. There are also collectors who buy directly from commercial and backyard farms and sell them to consumers either dressed or live.

Aside from live bird markets, there are traditional markets (locally called pasar) or wet markets that operate daily, where live birds are also sold. The poultry section is separate from other commodities (although within the poultry section, there are no separate compartments between species such as ducks, kampong chicken, and cockerels) and has a

section for slaughtering and carcass selling activities. The majority of consumers still prefer fresh chicken that are available in the neighborhood at affordable prices than frozen chicken, although frozen and processed poultry products are commonly available, particularly in urban areas.

It has been observed that these activities have inadequate hygienic and sanitary conditions. There are speculations that lack of biosecurity practices (including proper handling of waste disposal) and unrestricted poultry movements and trading are factors that contribute to the disease spread of AI in Indonesia. There is also anecdotal evidence of sick chicken being illicitly sold at a lower price than the prevailing market price to avoid loss in income.

Kenya

Poultry marketing in Kenya is also highly concentrated in wet markets, where 80% of the chicken and eggs are supplied by the semi-commercial farms and 30% by the backyard/village farms (raising indigenous breed). Smallholder farmers sell their eggs and chicken in primary markets in their vicinity or directly to secondary markets.

The large industrial integrated farms do not sell their broilers and eggs directly to wet markets. The industrial integrated sector imports poultry breeding stock (parent birds or fertilized eggs) mainly from Mauritius, Holland, Egypt, India and South Africa. Hatcheries sell day-old chicks to local commercial and smallholder farmers while the rest is exported to neighboring countries, mainly Uganda, Tanzania and Ethiopia. Large commercial farms sometimes contract smallholder farmers and supply them with day-old chicks and feed. Some of the eggs produced in large scale farms are exported. The rest are sold in secondary and tertiary markets. Some chickens are also sold to meat processors who either sell them locally in secondary and tertiary markets or export certified brands e.g. Halal Chicken. Contract farmers deliver part of their produce to large scale farms. Secondary markets supply supermarkets, restaurants and consumers in urban areas. Traders in secondary markets eventually sell mostly to tertiary markets – restaurants and hotels as well as to urban consumers.

Backyard farmers source out their indigenous chickens from neighbors, hatcheries, markets, and relatives. The chicken keeping households sell live birds either directly in the local markets or to primary collectors (middlemen), who eventually sell in local markets, which include individuals, kiosks, shops and small restaurants mainly in the rural areas. Primary collectors also sell some chicken in secondary markets in the urban areas. Some of these secondary traders sell to the tertiary markets that distribute the chickens to supermarkets, kiosks and small restaurants in urban areas. Eggs from the chicken keeping households are sold to (i) neighbors, (ii) primary egg collectors and (iii) directly to the local market. Primary collectors and local market operators then sell the eggs in secondary markets in the urban areas from where they are sold to tertiary markets. Like in the case of commercial chicken, the proportion of chicken traded at each stage of the value chain is unknown. In addition, no traceability mechanisms have been instituted in this system. Such a mechanism would be challenging because this production system is highly informal and is not as organized as the commercial production system.

Nigeria

As in the other study countries, poultry marketing in Nigeria is both informal and formal depending on which type of farm the chicken and eggs come from. Eggs and broilers produced by small-scale commercial farms are usually sold directly to the retailers or through middlemen (wholesalers, rural and urban traders, and agents) who transport the products from the farm to customers in the retail market such as food outlets, shops and live bird markets.

Backyard farmers sell their chickens (including matured cocks and unproductive hens) and eggs in live bird markets or directly to consumers in their village and nearby villages.

Birds produced by integrated farms are marketed commercially. They sell their products (including frozen whole and chicken parts) to consumers through a number of sources including supermarkets, distributors, fast food companies, hotels and restaurants, and open markets (Agene and Oguntade 2006).

Importance of the poultry sector on livelihoods and nutrition of the poor

Poultry production comprises an important contribution to rural household income and livelihood. Poultry is a significant livelihood asset especially for backyard poultry producers in both rural and peri-urban areas, whether for consumption or commercial purposes, because it requires very little labor, low inputs, low investment, and high reproduction rates. An acute outbreak, which could be a short one, may have a major impact on 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 them until the disease is eradicated. Thus, substantial removal of poultry from producer households reduces their income and thus cuts down their budget to buy other types of food.

A common feature among backyard poultry farms across the five study countries is their preference for raising indigenous (local or native) breeds, prompted by a number of factors including taste and texture of meat and cultural practices. HPAI outbreaks have created fears, particularly among consumers, because of the definite animal to human transmission and the possibility of the virus becoming a pandemic.

As in any other poultry disease (like new castle disease (NSD) and infectious bursal disease (IBD)), the direct economic impact of HPAI includes income losses resulting from 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. This category includes 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 poultry 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

remains to be 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 for micronutrient deficiencies, particularly iron deficiency. Infants and young children are more likely to be fed eggs than other family members and the absence of eggs in their diet could significantly reduce their intake of essential micronutrients. Micronutrient malnutrition in children could cause stunted growth and lowers the immune system and consequently increases levels of morbidity and mortality.

As shown in Table 9, consumption per capita for chicken meat did not decrease in the study countries after 2003 except for Kenya. Poultry is a major source of animal proteins and is generally part of the Kenyan household diet. Consumption per capita of chicken meat and eggs between 2000 and 2005 dropped by approximately 15.7% and consumption of eggs per capita has dropped by 1%. This may be suggestive of the fact that even though poultry production is on the rise in Kenya, it is not sufficient to meet the demand of a fast-growing population. The demand for eggs is expected to outstrip supply in the year 2010, while demand for poultry meat will just balance supply over the same period.

In Ghana, consumption of chicken meat per capita has increased substantially in comparison to the other countries, but egg consumption remains low even though its production has increased slightly.

In the case of Indonesia between 2000 and 2005, consumption per capita has increased by 9% for eggs, and by 7.9% for chicken meat. These figures imply that chicken and eggs are dominant in the Indonesian diet. A more updated consumption data from the Central Agency of Statistics reported in Annex III (Sumiarto and Arifin 2008) show that consumption of chicken meat (broiler and non-broiler) increased slightly over the period 2004-2006, although an AI outbreak occurred in some regions in Indonesia during that period. The consumption level of chicken meat in 2004 was recorded at 2.08 kilogram per capita per year, and increased to 2.3 kilogram per capita per year in 2006. However, the consumption of eggs decreased from 3.45 kilogram per capita per year in 2004 to 3.04 kilogram per capita per year in 2005. The income elasticity of demand for poultry products in Indonesia is very elastic, which makes it very sensitive to income changes. In addition, substitution elasticity of demand for poultry products is also high, implying that when the prices of poultry products increase, the consumers would easily substitute the poultry consumption with beef, fish, etc (Oktaviani, 2008).

Relative to the five 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.

Table 9. Consumption of chicken meat and eggs in the study countries, 2000 – 2005

Chicken meat (per capita)

	2000	2001	2002	2003	2004	2005	Growth Rate (2000 – 2005)
Ethiopia	0.58	0.70	0.72	0.71	0.62	0.64	1.99
Ghana	1.59	1.86	2.26	2.73	3.23	3.71	18.47
Indonesia	4.18	4.93	5.45	5.55	6.17	6.12	7.92
Kenya	1.27	1.15	1.02	0.87	0.71	0.54	-15.72
Nigeria	1.44	1.49	1.56	1.61	1.63	1.64	2.64

Eggs (per capita)

	2000	2001	2002	2003	Growth Rate (2000 – 2003)
Ethiopia	0.38	0.49	0.49	0.45	5.80
Ghana	0.84	0.84	0.86	0.87	1.18
Indonesia	3.03	3.2	3.54	3.92	8.96
Kenya	1.5	1.5	1.48	1.45	-1.12
Nigeria	3.07	3.29	3.28	3.27	2.13

Source: calculated from data obtained from FAOSTAT, accessed on June 2007

Hence, the importance of poultry on people's livelihood and nutrition cannot be overemphasized as it provides sustainable income at minimal investment and is also a cheap source of protein, especially for poor households in the developing world. The importance of poultry on the national economy and rural livelihoods of the five countries studied are discussed in detail in the annexes to this synthesis paper and are summarized below.

Indonesia

The contribution of the livestock sector to agricultural GDP in 2006 was about 12.8%, while the share of the poultry sector to total GDP was 1.8% (Central Agency of Statistics). The rate of growth of the livestock sector was 4.5% per year between 2001 and 2006, which was quite high compared to the negative growth of 1.9% during the peak of economic crisis from 1998 to 2000. The high dependency on imported feed and the sharp increase of the price of day-old chicken (DOC) are among the main contributors of such a negative growth, as small and medium scale poultry companies were not able to access the inputs. Interestingly, the livestock sector's share of GDP has started picking up again after the crisis with the poultry sector as the major contributor to the rapid growth, despite the occurrence of AI outbreaks in several parts of Indonesia since 2003.

CASERED (2004) have carried out an analysis to determine the impact on the systems and sectors of the Indonesian poultry industry. They have focused their analysis on sectors 1 to 3 stating that sector 4 was not influenced by the HPAI outbreak as the prices for their products did not change, their investment was small and poultry make insignificant contributions to household income. CASERED reported that 15 out of 30 of the Indonesia provinces were affected with 16.2 million poultry killed or stamped out in control efforts. The losses in terms of bird cost alone would be between US$16.2 to 32.4 million. In addition to farm level

impacts, CASERED (2004) reported drops of between 45 to 60% in the demand for day-old chicks and feed inputs during the outbreak, and a reduction of just over a third in the employment in the poultry industry.

Ethiopia

Research results showed that rural households consume a very limited quantity of poultry products since they rank cash income as the primary purpose of village chicken production (Bush, 2006). Poultry consumption is closely associated with wealth status. The poorer the household, the fewer poultry products are eaten. Chickens are not a daily food even for a better-off household. Chickens are consumed mostly during holidays, when the famous Ethiopian traditional dish, i.e. *doro wot,* is prepared for the special occasion. In general, poultry consumption accounts for less than 1% of the total annual food needs of farm households (Bush, 2006). Notably, chickens comprise the welcome feast for visitors; chickens are a source of food for women post-birth; chickens are payment to villagers for local health services; chickens are gifts to newly married couples; and chickens strengthen social networks between women (Bush, 2006). In addition to these, the spiritual benefit of the sacrifice of indigenous chicken types also has an important place in the cultural, social and religious functions of Ethiopian society (Tadelle and Ogle 2001).

Ghana

Livestock and poultry together contribute 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. The local poultry production in 2004 was about 23,000 tons.

The intensive poultry industry is a major supplier of poultry meat and eggs to urban markets, but there is no data available on volume and value of poultry products sold. The industry also provides employment opportunities ranging from poultry attendants to truck drivers to professional managers.

Data on the value of commercial poultry products sold in any one year is not currently available. 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 to professional managers.

In the case of the importance of backyard poultry in Ghana, Blackie (2006) conducted a study on the role of scavenging local chicken in rural household livelihood in the Greater Accra Region and reported that the main reason for keeping chicken was for consumption. These households indicated that the contribution of chicken to their animal protein intake was only 2.7%. In terms of its contribution to household income, the study estimated that family chicken contributed about 5%, on average, to the household annual net income, which shows that chicken is not their main source of income. Similarly, the study conducted by Aboe *et. al*. (2006a), also 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.

Kenya

The poultry sub-sector contributes about 55% to the livestock sector and 30% of the agricultural GDP or 7.8% of the total GDP (RoK, 2007). The sub-sector employs about two million people directly in production and marketing and indirectly through linkages with suppliers of inputs such as day-old-chicks, feeds (particularly feedmillers) and veterinary services. The food industry where poultry products are mainly consumed is highly integrated with tourism, which contributes about 19% to the overall economy.

The poultry sector is also linked with sports (cock fighting) and agricultural shows; cockerel fighting is a big attraction in some communities in Kenya. Part of the income derived from poultry farming is appropriated as government revenue, the rest forms an important pathway out of poverty especially among the rural population.

Kimani (2006) suggested that raising poultry is an important income generating activity in the 319 households that were sampled from eight districts in Kenya where it contributed 73% of the household income. In terms of gender roles in decision making in poultry production, women have more say than men in terms of income from eggs and live birds. In general, in the village poultry production system, women are involved in the rearing of chickens and marketing of eggs and live birds. Buyers at the farm gate are usually men who act as primary and secondary collectors. Local turkeys and ducks are usually owned and reared by women (FAO, 2007).

Poultry also play important social and cultural roles among poultry keepers (Njenga, 2005; Kimani, 2006). The use of poultry as a source of food is very important, as there are few alternative animal protein sources available for the poor (Njenga, 2005). Poultry meat and eggs contribute to a well balanced diet as there are few cultural or religious taboos that hinder the consumption of these products. Meat and eggs are rarely consumed in the rural areas except during special occasions. According to Kimani (2006), the provision of animal proteins in the form of eggs and meat for household consumption was the most important reason for keeping poultry among the 319 households interviewed (Kimani, 2006).

Nigeria

The contribution of poultry meat and eggs to total livestock output in Nigeria increased from 26% in 1995 to 27% in 1999 (Ojo, 2005). Chicken is the most commonly kept poultry product with an estimated population of 82.4 million (Bourn et al. 1992) compared to ducks and other fowls (31.9 million). In particular, the contribution of village poultry in the national economy of Nigeria has been significant over decades. Akinwumi's et. al. (1979) work shows that family poultry contributed 61% and 19.5% to the total poultry meat and egg production, respectively, between 1977 and 1978 in Nigeria. Also, evidence from Sonaiya et. al. (1990; cited in Sonaiya, 2007: 134) indicates that family poultry contributed 68.9% of the total poultry meat produced in the country. From these figures, we can say that poor smallholders really 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.

The average Nigerian consumes only about 7 grams of animal protein per day compared to the minimum daily requirement of 28 grams. There is also high potential in increasing egg consumption given that egg is rich in vitamins B6, A, E, and B12, energy and folate.

3. The Poultry Sector and Associated Level of Biosecurity in Study Countries

Throughout the world, there has been a major structural change in the poultry industry (Narrod and Pray, 2001; Delgado *et al*., 2008). Specifically, the commercial poultry industry in the developed world and in many developing countries has moved towards large-scale vertically integrated broiler operations that contract grow-out operations to smaller farmers. These operations are characterized by a high level of vertical control (ownership) or coordination between suppliers of production inputs, poultry growers, poultry processors and marketers.

Henry and Rothwell (1995) suggest that the main reasons companies vertical integrate are a) to gain from economies of scale and thus optimizing capital resources; b) for market ownership and margin control, which enabled a company to compete by lowering its production costs, by controlling the technical inputs into production at all levels; and c) to maintain a certain amount of biosecurity and quality control.

Although it appears that there is a move to integrated operations in a number of developed and developing countries, for the study countries in this project production practices are such that the majority of producers still maintain small flocks which are kept outdoors (free range or scavenging) and are exposed to outside influences. In Kenya, over 75% of the total chicken population is kept in backyard flocks, with almost all of the commercial production located in urban and peri-urban areas (Omore, 2001). The majority (over 85 per cent) of households with indigenous chickens keep less than 20 birds. In commercial systems, the average flock size is between 100 and 1,000 birds (Okitoi et al., 2000). Birds from commercial systems can sometimes mix with backyard birds. The occasional sale of birds from subsistence farms involves little or no additional marketing costs (Omore, 2001), and thus may promote the spread of AI. In Ethiopia, rural poultry contributes over 80% of the national poultry production and though commercial poultry exists, it is poorly developed (Morgan, 2006).

Though it is thought that other countries in the region are likely to have characteristics similar to those observed in Kenya and Ethiopia, there remains a lack of understanding in this region of the current structure of the poultry industry, the role of the public and private sector in monitoring and preventing diseases, and the movement of commercial and backyard animals through the supply chain. Similarly, nearly 50% of the population in Western Africa lives below the poverty line, and for many, backyard poultry is a substantial form of savings and income generation. The poor tend not to have money to build chicken coops or buy soap for better hygiene.

Structure of the poultry sector in study countries and location

Over the years, worldwide, there have been a number of attempts to describe and differentiate poultry production systems considering that there are various methods of rearing poultry—from large-scale, vertically integrated industrial farms to village-level, subsistence and scavenging poultry operations (see Table 10). One classification that was

defined by Kitalyi (1998) was based on flock sizes and genetic breed, such as intensive, semi-intensive and extensive/scavenging. The structure of the poultry sectors in most African countries, such as Ethiopia, has been classified according to these categories. The intensive system, which is based on specialized breeds, constitutes less than 30 % of the total poultry population in Africa. The system is found mainly in urban areas, where there are markets for eggs and chicken meat. In those countries that followed a socialist policy, such as Ethiopia, the intensive poultry production system was confined to government institutions (Katule, 1989). The 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 system flocks range from 50 to 200 birds (Kitalyi, 1998). The extensive poultry production systems in Africa, where the poultry is kept on free range or scavenging is different from the more recent extensive free-range poultry in developed countries (Thear, 1997).

FAO (2004) has also developed a classification of the poultry production system based on the level of biosecurity and marketing practices. Biosecurity measures are application of health control measures to prevent or reduce the risk of disease introduction and spread. The aim of these measures is to build and maintain effective barriers to the entry of unwanted pathogens (Sims and Narrod, forthcoming). These may be physical barriers or barriers created by specific operational procedures.

According to Sims and Narrod (forthcoming), the risk of introduction of the avian influenza virus into a farm is determined by a complex interaction between the levels of infection in an area (which varies over time) and the likelihood of carriage of the virus into a farm. The likelihood depends on the number of 'contacts' outside the farm and the probability of these contacts leading to virus spread. This risk is modified by the biosecurity measures practiced on the farm. With these taken into consideration, FAO classified the poultry system into four sectors based on four levels of biosecurity measures.

Poultry farms classified as Sector 1 are usually part of an integrated industrial system with a well defined system for implementing biosecurity. Sector 2 is differentiated from Sector 1 in terms of the level of biosecurity, which is moderate to high where birds are kept indoors continuously to prevent contact with other poultry and wildlife. Production units in Sectors 1 and 2 tend to be large scale, with well organized biosecurity systems and quality control processes. Birds and poultry products are marketed commercially and export usually takes place from Sector 1. A well-run Sector 1 or 2 farm in theory has a good chance of spotting suspect cases of HPAI early. However, it is recognized that even when there are sentinel cases, the general awareness of the disease may still be low, resulting in delay in identifying susceptible cases.

Sector 3 farms are commercially oriented, but tend to be less biosecure. Furthermore, Sector 3 farmers in developing countries may sell into more than one market, including live bird markets, with differences in prices, and may change their pattern of sales by season, in a way that is predictable but not documented. They may also sell through middlemen. Sector 4 flocks are kept with minimal inputs. In most places, birds roam freely (free-range, backyard or semi-intensive systems) around the farmstead or village, in others they are kept

in family courtyards enclosed by walls, but in either situation they eat household scraps and what they can find in the environment. Birds and eggs are primarily for consumption in the households that produce them or are sold to neighbors or in local markets so the owner can easily be identified.

Another classification is the modified system adopted by UNDP in which poultry production systems are grouped according to flock size, type of birds kept number of species reared together, level of biosecurity and the marketing channel for birds and products.

The following characterizations of the poultry system for each of the five countries are based on the classifications by FAO, UNDP, and Kitalye. Obi et al (2008) adopted the UNDP's classification of Nigeria's poultry production system as they discussed the poultry structure in Nigeria (see Annex V). In Ethiopia, Alemu et al (2008) used Kitalye's classification and linked them to the FAO classification. In Ghana, Aning et al (2008) based their characterization of the poultry sector in Ghana on flock size, marketing system, and level of integration of its operations. Sumiarto and Arifin (2008) followed similar characteristics, i.e., level of integration and production technology—intensive vs. extensive—in describing Indonesia's poultry sector. Similarly in Kenya, Omiti and Okuthe adapted Kitalye's definitions and attempted to link FAO's classification with the current poultry structure.

Ethiopia

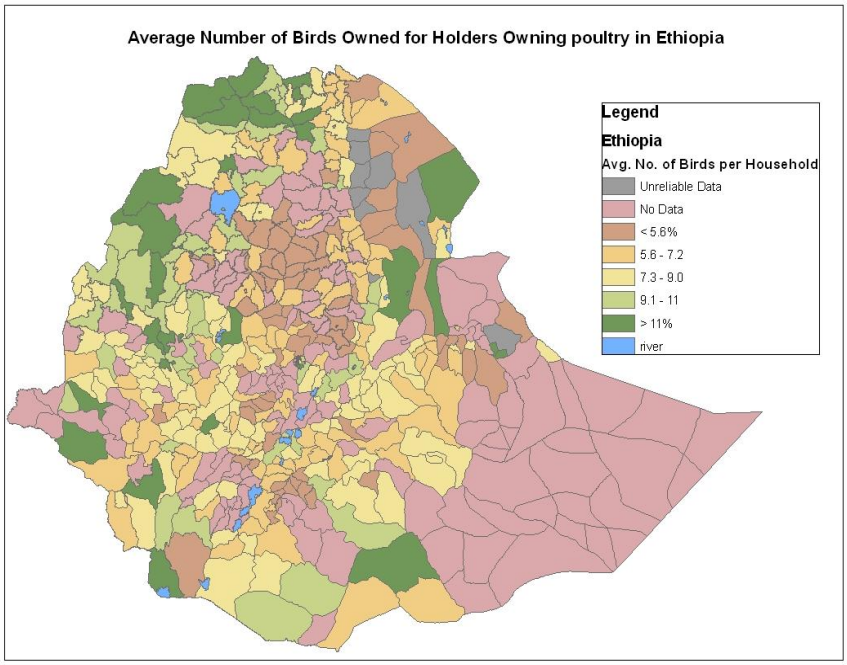
In Ethiopia, poultry is one of the main types of livestock raised particularly by small-scale farmers. Though there are a number of producers, the poultry sector is mainly unorganized and the link with other sectors seems weak (owing to localized small markets and the limited role of purchased inputs). Most of the poultry production in Ethiopia can be characterized as rural poultry production that is highly localized in terms of input and output markets. Alemu and Tadelle (1997) claimed that rural poultry contributed about 98.5% of the national poultry meat production, and 99.2% of the national egg production. In 2006, Morgan (2006) indicated that rural poultry contributes over 80% of the national poultry production . Of these birds, only 27% are produced for sale, while 25% are used for sacrifice or healing, 20% for replacement, and only 20% for home consumption.

Though a livestock census has not been done since 1998, CACC (2003) estimated indigenous poultry population at 42.9 million in 2003 while the Central Statistics Agency (CSA) reported 30 million indigenous chicken and about 1 million commercial exotic chicken. More recent data from the 2006/07 Agricultural Sample Survey of the CSA suggest that of a total poultry population in Ethiopia estimated at 34.2 million, 95% are low-yielding indigenous breeds, while only 4% are hybrids and 1% exotic breeds (Alemu et al 2008, Annex I). Although there is no exact figure representing the Ethiopian poultry population, the figures suggest that the poultry sector is largely confined to local-level production and consumption, with only a small portion incorporating modern technologies (in the form of hybrid or exotic breeds and the techniques required to raise them) that are typically produced for larger, more market-driven production and consumption purposes.

Demeke (2007) estimated that about half of all Ethiopian smallholders own poultry, although this varies somewhat by region. Poultry rearing is most frequent in the northern

and western parts of the country, particularly in Amhara, Tigray, Benishangul Gumuz, and Gambella. In the south and east, particularly in the pastoral areas, poultry is much less common. Here, poultry includes cocks, cockerels, pullets, laying hens, nonlaying hens, and chicks. Of a national poultry population of about 43 million birds, chicks constitute the largest share (about 40%), followed by laying hens (about 25%) (Demeke 2007). Figure 3 shows the average number of birds owned per household. The national average is 7.2 birds per poultry owner. While ownership varies throughout the country, larger flocks tend to be held by owners in the western parts of the country, particularly in lowland areas.

Figure 3 Average number of birds owned per household, 2002



Source: IFPRI 2006. Atlas of the Ethiopian Rural Economy.

http://www.ifpri.org/pubs/books/oc54.asp

Ethiopia's poultry sector can be classified into four main types: commercial, government owned breeding and rearing centers, small-scale commercial/intensive, and subsistence or traditional poultry systems (Figure 3). Subsistence or traditional poultry is typically a household-based activity in which women or children are charged with rearing 10 – 20 birds that are raised for eggs and meat for household or local market consumption. The birds are indigenous breeds that survive by scavenging, occasionally supplemented by small quantities of cereal thrown at them. This poultry system falls under FAO's Sector 4 classification.

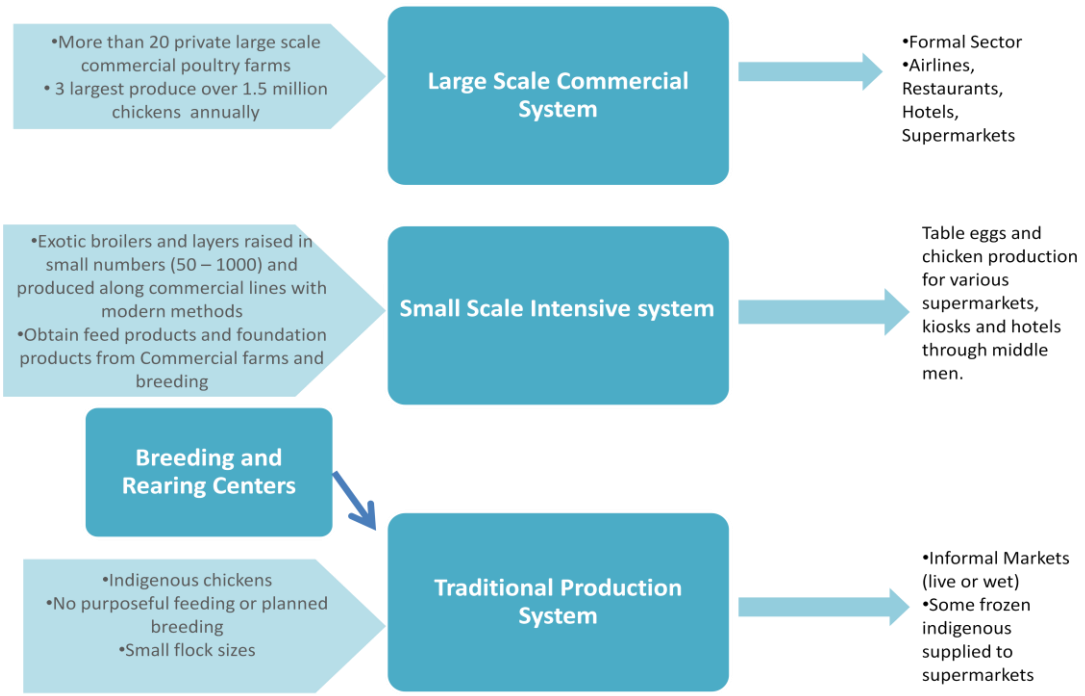
Small-scale commercial poultry operations, which can be classified as Sector 3 as per FAO's definition, vary in size, but on average are above 100 birds per household. These farms could either be kept as supplementary to family income or as a full time business. The birds kept are typically exotic breeds, and are held in purpose-built enclosures and provided with high-quality feed and water. Although small-scale commercial poultry is relatively rare, clusters have emerged in the Addis Ababa market-shed (e.g., in Debre Zeit-Mojo corridor) and in other growing urban centers in Ethiopia.

Within the poultry sector, the Ministry of Agriculture's Animal Health Department (MoARD) in cooperation with higher education and research institutions owns multiplication centers responsible for breeding parent stock and distribution of fertile eggs, baby chicks and pullets and cockerels particularly to subsistence or traditional poultry farms in rural villages. Some of them have hatchery units, brooder and layer houses, and veterinary clinic and feed processing units. The centers directly import fertile eggs and day-old chicks of dual purpose chickens (commonly Red Island Red (RIR)) as parent stock from foreign countries. The government operates a total of 14 modern multiplication centers.

The commercial poultry sector is developing in Ethiopia and is highly concentrated in Debre Zeit. The commercial poultry farms maintain over 1,000 birds and use modern feeding and other production technologies (which is Sectors 1 and 2 by FAO definition). These farms are highly dependent on the market for inputs, and the owners are wealthy by Ethiopian standard. These have formal agreements with airlines, supermarkets, hotels, restaurants, universities and other institutional consumers to supply poultry meat and eggs (Figure 4). There are more than 20 private large-scale commercial poultry farms, which are supported by a range of other private actors including breeding and hatchery companies, breeding stock importers, and feed processors. Poultry vaccines are purchased from the National Veterinary Institute (NVI), while credit and financial services are provided by both Ethiopia's Development Bank and by commercial banks.

In all the above cases, it is likely that the traditional or subsistence poultry farms will be less subject to government sponsored disease inspection and control than larger operations. In countries where this type of production system dominates, there is a greater likelihood that an undetected, smoldering infection may exist.

Figure 4 Poultry structure in Ethiopia



Note: State-owned breeding and rearing centers or multiplication farms supply fertile eggs, day-old-chicks, pullets/cockerels, culled layers to traditional poultry farmers at subsidized rates.

Source: Demeke, S. 2007.

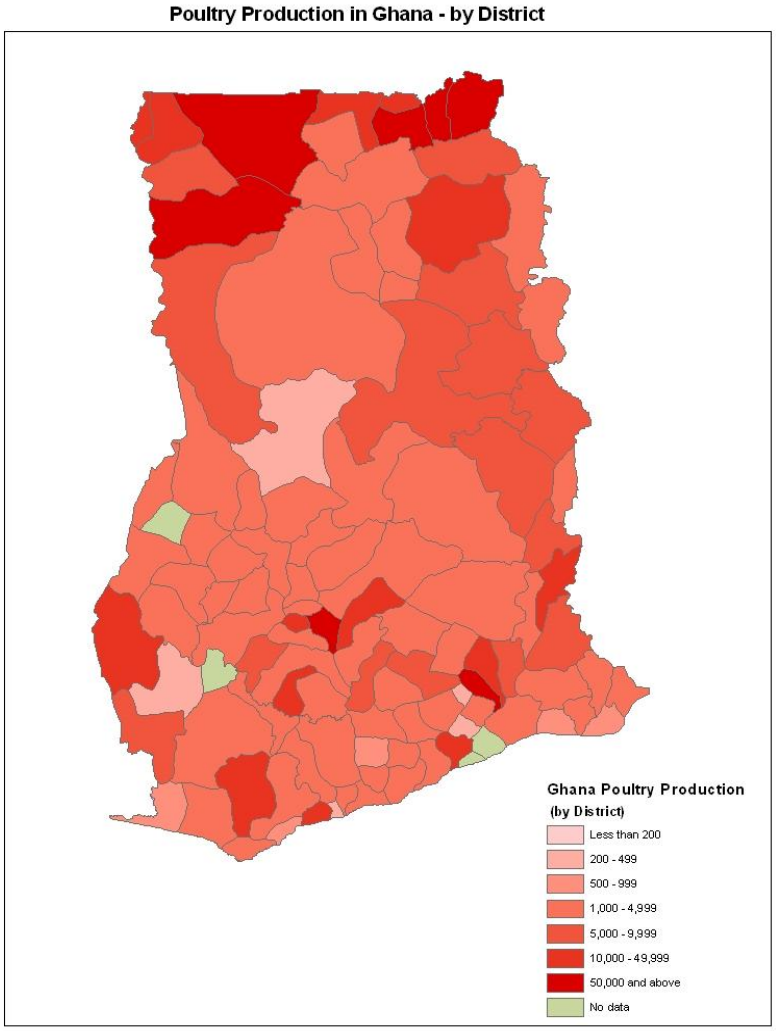
Other clusters are also emerging in more rural parts of the country. For example, there is evidence of an emerging preference for and good performance of hybrid and exotic poultry breeds in rural communities in the central and northwest zones of the Tigray regional state (CSA 2007). Although Tigray accounts for just 10% of the total poultry sector (including indigenous, hybrid and exotic breeds) in Ethiopia, the region hosts the largest share of exotic breeds (36%), and the second highest share of hybrid breeds (28%) in the country.

Ghana

Poultry production in Ghana is mainly a smallholder activity, with a few large commercial farms located in Ashanti, Upper West, Upper East, and Northern regions (Figure 5). There are wide regional disparities in poultry holdings and in the structure between these two poultry production systems. It is estimated that about 1.2 million households in Ghana raised poultry domestically during 1999. The pattern of poultry production has not changed much since 2000, even though the domestic commercial production of broilers as well as the traditional backyard production and sale of live birds both seem to have shrunk in recent years.

The preference of chicken seems to have changed over time from that of whole chicken to a demand for some chicken parts, especially chicken thighs and wings. This is impacting on the feed industry and the demand for maize, which is an important feed ingredient as well as other locally produced feed ingredients such as soya beans, fishmeal, oyster shells, salt etc.

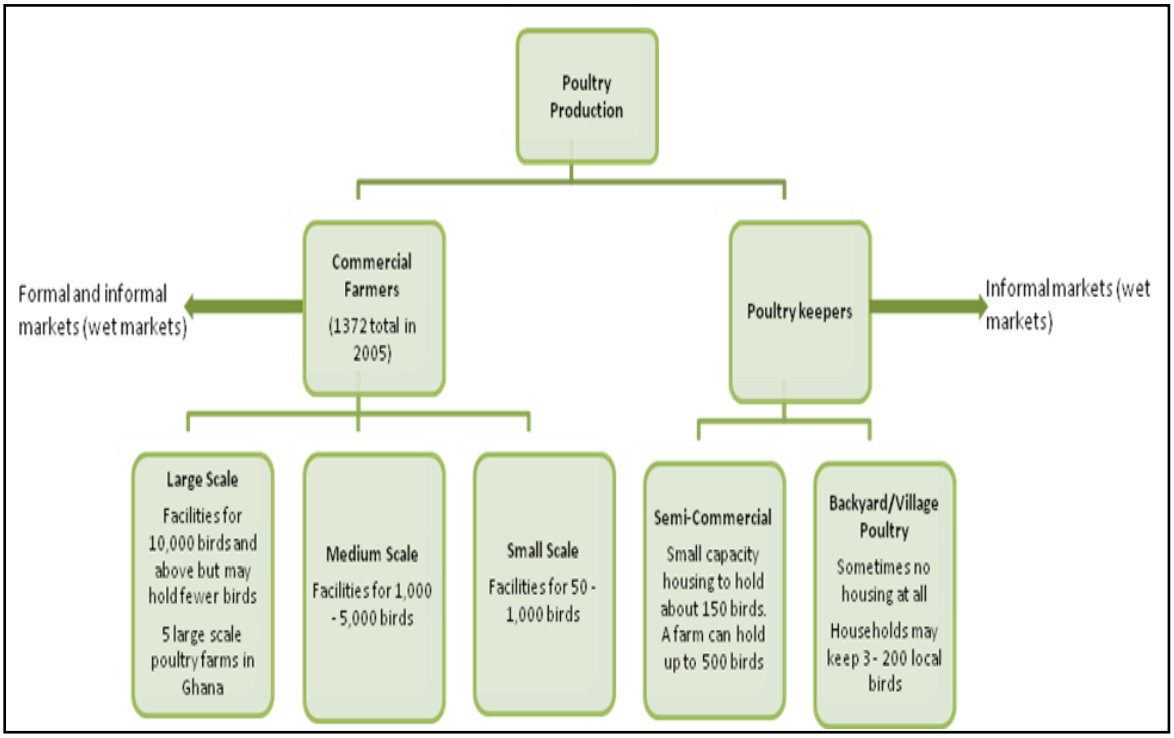
Figure 5. Distribution of poultry production in Ghana (2005)



Source: GLSS5

Aning et al (2008) classifies poultry production in Ghana into 3 categories (large-scale commercial (or industrial); medium semi-commercial; and backyard) based on flock size, marketing system, and level of integration of its operations (Figure 6). Large-scale farms tend to have flock sizes of more than 10,000 birds, operate their own feed mill, and hire at least 5 permanent workers. Currently in Ghana, there are only 5 such farms, which are privately owned by individuals or a family, and are located mainly in Ashanti, Greater Accra, and Brong-Ahafo. Except for some large-scale commercial farms that are vertically integrated with hatchery, feed mill, production, processing, and marketing, none of the poultry farms implement biosecurity measures comparable to FAO's sector 1 or 2 (Aning, 2006).

Figure 6: Poultry structure in Ghana



Source: Aning, K.G, P.K. Turkson, and S. Asuming-Brempong 2008, Annex II

Medium semi-commercial poultry farmers have a flock size of between 1,000 and 5,000 birds. They rely on large-scale integrated farms for their day-old chicks and feed, but also obtain feed from other sources. By definition, the medium and small-scale commercial poultry operations in Ghana could fall under FAO's Sector 3 with a low level of biosecurity. Birds are kept mainly indoors, on deep litter or in battery cages. Semi-commercial, small-scale farms typically keep below 500 birds. This system mainly comprises of traditional village poultry (chicken, guinea fowl, ducks, turkeys, doves) raised mainly to supplement incomes, for meat, and rarely for eggs (Aboe *et al*, 2006a). Backyard or village poultry farms are characterized by a low-input of feeding and housing, which makes it an important supplement to household income. Birds are mostly free-range, but are given supplementary feed and caged at night. This system falls under FAO's Sector 4 with very minimal biosecurity.

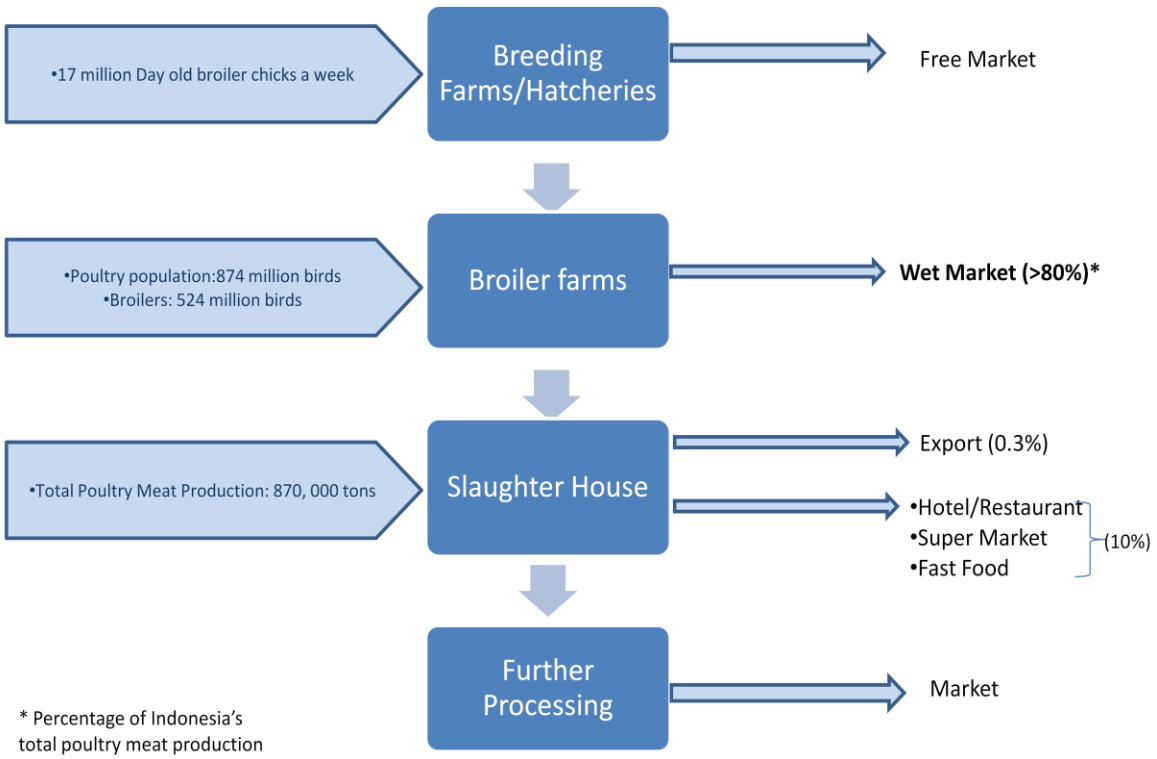
Indonesia

The poultry sector in Indonesia has been classified according to the level of integration and production technology used, and has also linked each sector to FAO's classification. Sector 1 is comprised of farms owned and managed by about ten large, multinational, and corporately-owned companies operating in Indonesia which produce a highly valued product with complete control over inputs and outputs (fully vertically integrated).[3] The farms are known collectively as the industrial farms, operating their own breeding farms, feedmills, broiler/layer farms, slaughterhouses, and processing plants (Figure 7). Sector 2 consists of breeding farms, some but not all of which are industrial farms. The industrial breeding farms are included in Sector 2 along with those breeding farms not owned and managed by the multinational companies, because as breeding farms they require special licensing and management. Sector 3 is predominantly the small commercial producers, with broiler farms either contracted to Sector 1 companies or working with 'local integrators,' while the layer farms are generally independently owned and managed. Sector 4 is the village or kampong chicken sector. According to Sumiarto and Arifin (2008), the village or kampong poultry system can be classified as intensive/semi-intensive and extensive traditional. The majority of the kampong chicken are free-range and scavenge for feed during the day (with supplement feed from left-over foods and locally produced feed) and kept in cages at night. The intensive/semi-intensive uses a method similar to the "all-in-all-out" system.

There are nearly 16,000 farms that have a high level of biosecurity and are associated with an industrially, integrated system (sectors 1). These farms are export oriented and are estimated to have a total population of 9.7 million birds. The commercially oriented production systems (Sector 2) are estimated to have 58.2 million birds in 83,000 farms. The poultry sector in Indonesia is dominated by Sector 4, which is estimated at 175 million birds (Rushton et al 2005); Sector 3 is estimated to have 32.4 million birds. In Java alone, there are 106 million kampong chickens reared by approximately 70% of the households. The estimated number of birds kept by village or kampong farms range between 50 or less birds to several hundred (Sumiarto and Arifin 2008). These two sectors comprise about 80% of the national poultry population, although there appears to be some inconsistencies as to the real size of the national poultry flock.

[3] These companies include PT. Charoen Phokphand (CP), PT. Japfa Comfeed, PT. Wonokoyo, PT. Anwar Sirad, PT. Malindo, PT. Patriot, PT Cibadak, PT. Reza Perkasa, and BIP. Nearly 70% of total production from this sector come from the top three companies: CP (27%), Japfa (23%), and Wonokoyo (19%). These companies supply the breeding stock from which almost all the commercial poultry meat and table eggs are derived in Java.

Figure 7. Structure of poultry farms in Indonesia



Source: Sumiarto, B., B. Arifin 2008, Annex III.

Kenya

Poultry keeping is one of the most popular livestock enterprises in Kenya due to its low capital space requirements. In 2006, Kenya had an estimated 37.3 million birds (MOLFD, 2007)[4]. Of these, free-ranging indigenous birds comprise 84.1% (31.4 million); 8.4% were layers (3.1 million), 5.7% (2.1 million) were broilers while other poultry species (ducks, turkeys, pigeons, ostriches, guinea fowls and quails) accounted for the other 1.8% (0.7 million). The total poultry population in Kenya varied greatly between 2001 and 2006. The Rift Valley Province had the highest number of poultry farms, 99% of which are village poultry farms raising indigenous chickens, followed by the Eastern and Nyanza Provinces (Omiti et al. 2008). Most of the commercial poultry are located in the high and medium rainfall zone comprising the Central Province, Central Rift Valley and around Mombasa in the Coast Province (see Table 9 in Annex IV). Very few poultry are reared in the North Eastern Province and parts of the northern and southern Rift Valley (see Figure 2 in Omiti and Okuthe 2008, Annex IV).

Sixty-six percent of Kenyan households keep at least one type of livestock. Chicken and cattle are the most common livestock species and are reared by 67% and 64 %, respectively, of the livestock rearing households. Other livestock species include sheep, goats, camels, pigs and donkeys.

[4]This number varies in different studies; no poultry census has been carried out since 1976.

According to Okitoi et al. (2000) and Omore (2001), over 75% of Kenyan agricultural households keep poultry in their backyards, nearly all of which are indigenous chickens, with about 12 birds per household on average. The majority (over 85%) of these households with indigenous chickens keep less than 20 birds.

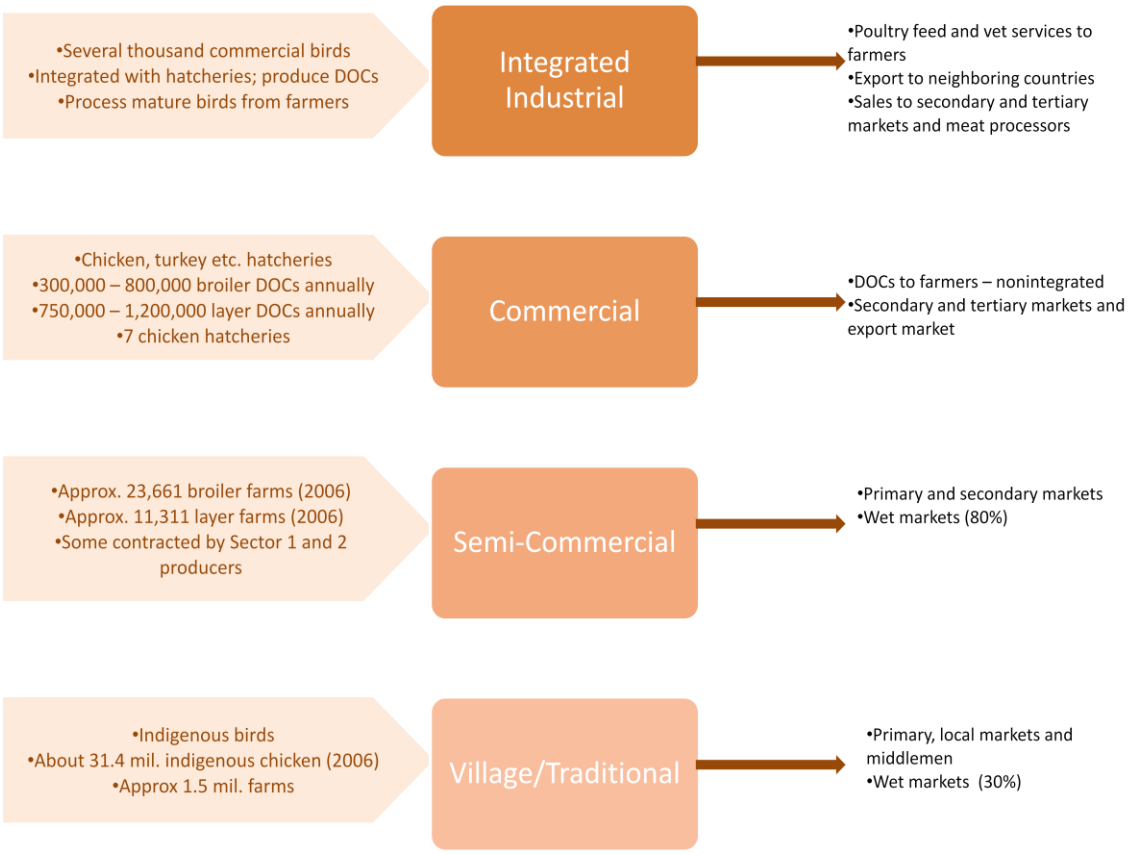
In commercial systems, which are located in urban and peri-urban areas, the average flock size is between 100 and 1,000 birds (Okitoi et al., 2000).

Sector 1 consists of the integrated industrial producers (big companies), Sector 2 is made up of commercial farms (mostly hatcheries), Sector 3 is dominated by smallholder, semi-commercial farmers while Sector 4 constitutes the village or traditional poultry production system (Figure 8). The village (traditional) poultry production system is comprised of indigenous chicken, ducks and turkeys and other poultry types kept in the rural areas and in the urban informal settlements. The numbers kept vary with the region, species and consumption needs. This is a low-input, low-output production system which involves low income households.

The large, fully industrial sector has high use of external inputs for housing, feeding and processing. The scale of production is large, consisting of several thousand commercial birds. Such farms are integrated with hatcheries that produce day chicks for use on the farm and for sale. Although these farms have their own hatcheries, they also import parent birds and fertilized eggs as well. Poultry feed is of high quality and is sourced directly from feed manufacturers. In this sector, companies usually contract small-scale outgrower farmers to maintain a steady supply of birds.

In the commercial poultry production system, this sector consists of hatcheries where poultry is bred and hatched for commercial purposes and day-old chicks are sold to farmers (FAO, 2007). Hatcheries are well linked with most players in the poultry industry and the rest of the economy. Most of the day-old chicks are sold to smallholder poultry farmers.

Figure 8. Poultry structure in Kenya



Source: Omiti, J., L. Ndirangu, and S. Okuthe 2008.

Nigeria

In Nigeria, poultry production is one of the key means of income generating activities and livelihood strategy. Though a census has not been taken since 1990, it has been estimated that more than 80% of the national poultry inventory (estimated to be 143 million) are found in free-ranging backyard poultry. Nearly all rural households hold 3-5 backyard poultry, and the bulk of backyard poultry is consumed within household and presents an important component of the diet. Almost every household in rural areas keep poultry in Nigeria.

Across regions, subsistence poultry keeping is higher in the south than in the north. The percentage of households rearing poultry is highest in the south zone (64.42%) followed by the south-west (56.44%), while the north-west has the lowest number of families that engage in poultry production (29.96%). In south west Nigeria, Ogun State has the highest percentage of households keeping subsistence poultry (74%) followed by Osun State (57.3%), while Oyo State has the lowest (42.4%). This is in line with expectations because Ogun State has one of the key international borders (Idiroko Border Station) through which poultry importation (legal and illegal) takes place. Ogun State shares boundaries with Lagos

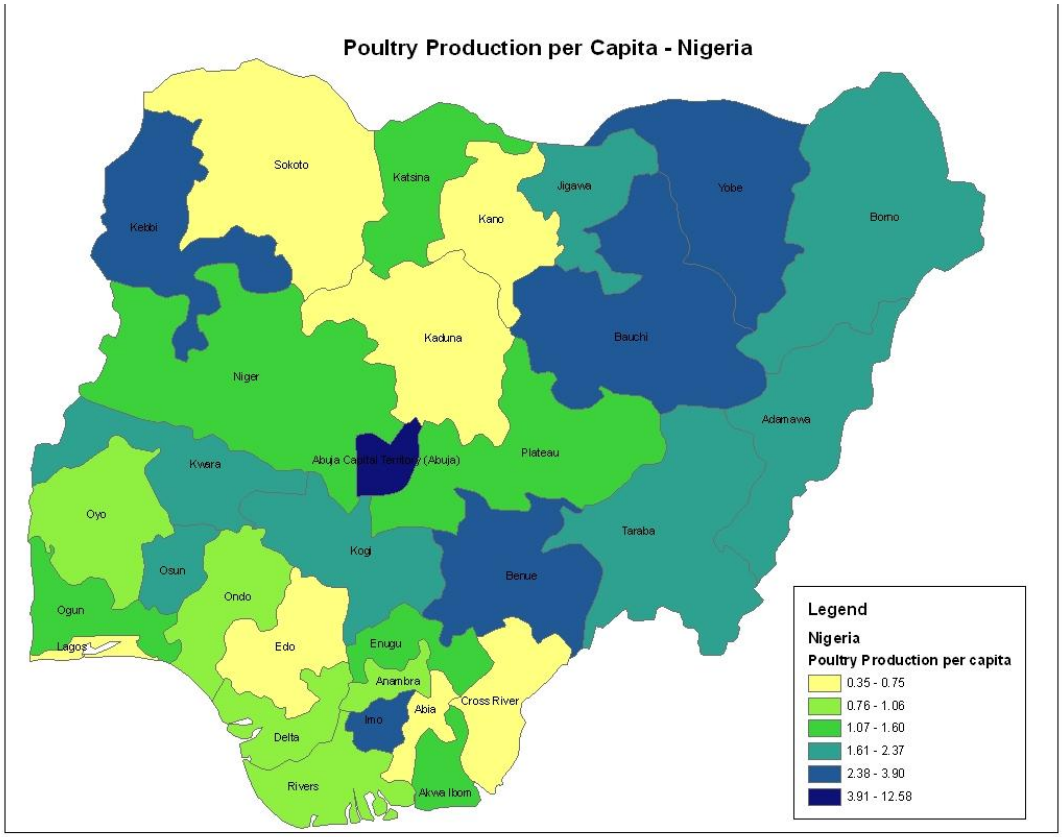
State, which is the economic capital of Nigeria. A good market for poultry products thus exists in Lagos, considering its high population figure and level of urbanization.

Common bird types in the Nigerian poultry sub-sector are chicken, turkey, ducks, guinea fowls and pigeons. Village poultry flock composition is, however, dominated by chickens. More chicken is generally kept per flock in the south. A higher percentage of households in the north keep other types of poultry more than those in southern parts of Nigeria.

Flock sizes are usually largest in the dry season (November – March) with a high number of chicks due to more favorable environmental conditions (e.g. temperature) for egg laying and hatching. Variations in village poultry flock size, entries (chicks and number of chicken bought-in, entrusted, or obtained as a gift) and exits (number of chicken sold, consumed, dead, and used as gifts, exchanged, or entrusted in other households) across the year are important as an indication of the period when HPAI or other poultry disease outbreaks will have a larger effect.

Some small, commercial poultry producing farms with flock sizes ranging from 1000 – 4999 birds are unevenly located across the six geopolitical zones in Nigeria. This sector focuses primarily on egg production with some farmers also engaged in broiler meat production simultaneously. Available data also show that most of these Sector 3 farms are located in Lagos and Ogun State, and those states close to them. This could be due to the fact that Lagos and Ogun State are the major entry points for imported poultry inputs, such as vaccines and drugs in Nigeria. Besides, the market for poultry products in Lagos and other southern states (especially eggs) is large.

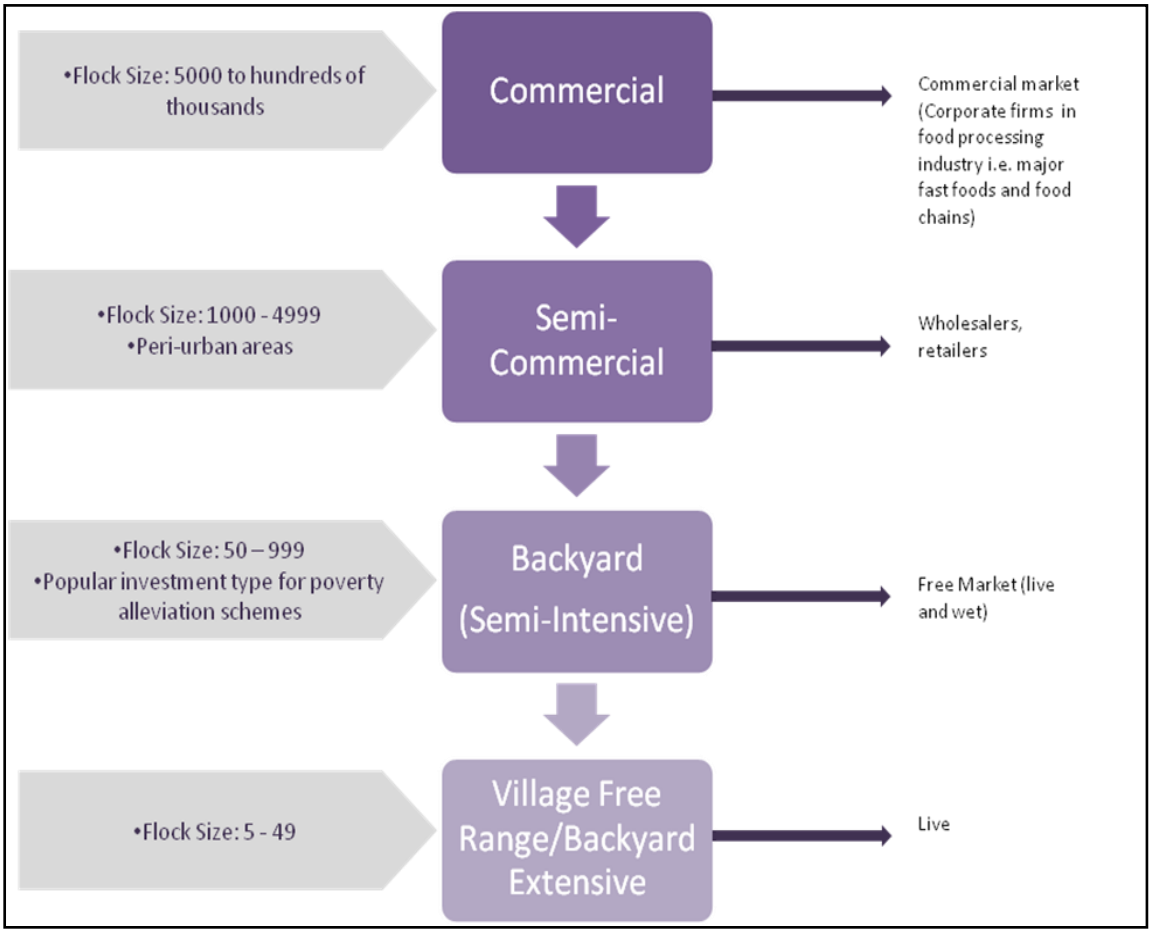
Figure 9. Distribution of poultry production per capita in Nigeria by state



Source: Uzochukwu Obi, T., A. O. Oparinde, and G.A. Maina 2008, Annex V.

The poultry sector in Nigeria has been classified by UNDP (2006) into four categories: village extensive, backyard (intensive), semi-commercial and commercial production systems based on flock size, housing, and level of biosecurity (Figure 10). FDLPCS (2007) states that backyard and/or village extensive production systems account for 60-70% of the total poultry population in Nigeria. UNDP (2006) indicates that the total number of birds under village extensive and backyard semi-intensive/intensive production systems constitute about 70% of the total poultry population in Nigeria. Semi-commercial systems account for 15%, while commercial take 25% of the total poultry population. Backyard (intensive) poultry producers are widely distributed in the peri-urban areas. The density of backyard poultry farms and markets for livestock inputs (feeds, drugs, etc) is very high in the Agege (Oko-Oba) areas in Lagos State and Oke-Aro areas in Ogun State. According to NBS (2006a), in 2000, the total value of local poultry was valued at N1.2 billion (approx US$0.1 billion), which is 0.3% of the total value of livestock in Nigeria.

Figure 10. Poultry structure in Nigeria



Source: Uzochukwu Obi, T., A. O. Oparinde, and G.A. Maina 2008, Annex V.

Sonaiya and Swan (2004) defined family poultry as ”small-scale poultry keeping by households using family labour and, wherever possible, locally available feed resources.” This definition clarifies that family poultry comprises a flock size of 5 – 100 birds in Africa, but recent data from a short survey by Adene and Oguntade (2006) show that this has increased over time in Nigeria. This is corroborated by the NBS data on household keeping subsistence poultry across geopolitical zones in Nigeria, where average poultry flock size per household is up to 177 birds in Delta State (South-South). It is also worth noting that extensive and backyard (extensive) poultry production systems are common in the rural-village while the backyard (intensive) system is common in rural-town and urban areas in Nigeria. In this case, it is difficult to attribute a flock size of 59 – 181 chickens to free-range or a village extensive production system (in the south-east Nigeria), which they regarded as the conventional rural poultry.

As in all other study countries, the village poultry production system in Nigeria is a ‘low input low output type’ with a small flock size. Mostly, the birds are not confined or housed and they scavenge on the available grass seeds and leaves, earthworms, insects, household food

wastes and other food materials found freely within the homestead or community. This could imply weak linkages with other sectors on the input side. Households usually engage in free-range village poultry production for their own consumption, while only a few sell their poultry products for additional income.

Large commercial farms of operation capacity within 5,000 and 100,000 birds dominate the commercial production sector. Many of those that have production capacity on the lower tail are widely spread in Lagos, Osun, Ogun, Oyo, Ekiti, Ondo, Delta, Edo and the northern states. The second group of large, commercial farms is those with relatively high production capacity, as high as 250,000 birds. They are few in number and are mainly found in the southern Nigeria.

In the village extensive or free range production system, birds mainly depend on a scavenged resource base (SRB) within the community. Owners of scavenging birds usually supplement the feed during the rainy season with cereal grains either purchased from the village market or stored during the harvesting period. A recent study in Borno State shows that millet bran is the supplement used the most among households involved in village chicken production followed by food scrap (Abubakar, 2007).

In the backyard semi-intensive/intensive production system, the flock is fed with a combination of feeds purchased from feed mills and shop outlets. Feeds are expensive, and as a result the smallholders usually produce feeds themselves using locally available inputs. Most backyard farmers produce their feeds using a mixture of local materials, like corn and bone meal, only or in combination with oyster shell, fishmeal, and wheat offal.

Commercial farmers obtain their feeds from both local and international sources. As discussed above, many operators in the commercial poultry sector have their own feed mill (Adene and Oguntade, 2006). These farmers do not produce feeds for supply into the market but mainly for their own operational consumption. Another common group in feed production in the country are the toll millers who do not package processed feeds into the market, but only mill ingredients for poultry farmers for a fee and thus are usually located within surroundings of livestock farms (e.g. Oke-Aro area in Ogun State and Oko-Oba area in Lagos).

The third group is the commercial feed millers with relatively large production capacity and modern technology (such as pelleting machines, roller mills/flakers, bran mixers, corn grinders, bagging units, and automation). They formulate, compound, and package feeds for sale to farmers in all poultry sectors.

Table 10. Characteristics of the poultry production systems for the five country studies

Characteristics	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
No. of birds kept				
Ethiopia	Above 10,000 birds		1,000-5,000	Below 500 birds accounts for 80% of poultry population
Ghana	10,000 and above	1,000-5,000	150-500 birds	3-200 birds
Kenya		100-1000	50-100?	<20 accounts for over 75% of the total chicken population
Nigeria	5000 and over	1000-4999	50-999	5-49 Accounts for >80% of national poultry inventory (estimated to be 143 million)
Indonesia	Average of 222/ broiler farm; 2,771/layer farm Not clear?	Average of 834/ broiler farm; 528/layer farm Not clear?		50 or less to several hundreds

Table 10. Cont.

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

Sources: Adapted from http://www.fao.org/docs/eims/upload//214190/ProductionSystemsCharacteristics.pdf; Demeke, S. 2007; Aning, K.G, P.K. Turkson, and S. Asuming-Brempong 2008, Annex II; Sumiarto, B., B. Arifin 2008, Annex III; Omiti, J., L. Ndirangu, and S. Okuthe 2008, Annex IV; Uzochukwu Obi, T., A. O. Oparinde, and G.A. Maina 2008, Annex V.

Current biosecurity measures in the study countries by sector

Each activity in the poultry farm that uses materials or equipment being brought into the farm represents a potential threat to farm biosecurity. To minimize the risk of introduction of pathogens requires sound management of biosecurity measures. For example, at the end of each production cycle, 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 and therefore appropriate measures such as crate and vehicle cleaning and disinfecting prior to use on the farm are required to ensure these 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 procedures for replenishing disinfectant footbaths are not followed. Enhancement of a farm biosecurity system requires behavioral changes for which farm workers and managers must be trained and the adoption of these practices should be monitored and audited regularly.

In addition, wild birds pose a potential risk to biosecurity because they can transfer pathogens, including H5N1 HPAI viruses (and other avian influenza viruses), to farms. Farms practicing high-level biosecurity implement measures to minimize the risk of contact with these birds, covering direct contact (e.g. netting to prevent entry of birds) and indirect contact (e.g. treatment of water from sources frequented by wild birds).

The following descriptions of the conditions of biosecurity measures in the five study countries are presented in more detail in the country background papers (Annex I to Annex V). It can be observed that biosecurity measures vary according to the type of poultry production system and geographical location (Table 11).

Table 11. Biosecurity measures to reduce the risk of AI during outbreak or in case there is outbreak in the five countries

Biosecurity measures	Industrial and integrated	Commercial not integrated	Backyard market-oriented	Village or backyard subsistence
	Sector 1	Sector 2	Sector 3	Sector 4
ETHIOPIA	2	2	1	0
GHANA	2	1	1	0
INDONESIA	3	2	1	0
KENYA	3	2	0	0
NIGERIA	3	2	1	0

Note: Level 0 means no biosecurity measures; Level 1-basic or low biosecurity measures; Level 2-moderately high or enhanced biosecurity measures; Level 3-high biosecurity measures;

Indonesia

Sumiarto and Arifin (2008) described the biosecurity measures in Sectors 1 and 2 as follows:

- Staff/worker using a bath with antiseptic soap entering the farm.
- Staff/worker prohibited moving from one flock to another flock.
- Vehicle for feed cleaned and disinfected before transporting or entering/leaving the premise.
- Vehicle for feed usually not allowed entering the location of farm.
- Fumigation for every vehicle and goods/materials arriving.
- Disinfection & sanitation period between production cycle (includes “all-in-all-out” flock management system, proper cleaning/disinfection & service periods etc.).

Routine animal health practices, including sufficient vaccination efforts against AI, are done by 100% and approximately 80% of breeding flocks and commercial layer flocks, respectively (Prajitno, 2008). Vaccination in general is widely used in commercial poultry with a long live production cycle, such as breeders and layers with various successes. In terms of veterinary services, large farms employ private veterinarians because access to official veterinarians is often limited.

In the case of Sectors 3 and 4 (raising Kampong or village chicken), there is low or no biosecurity measures in these types of production systems. Vaccination against HPAI is applied but differs widely across different regions in Java. The vaccination coverage remains generally low due to the high turn-over rate (expected >25% per quarter), not considering even the efficiency of the vaccine used nor the booster regimes. Veterinary support comes (if any) from public livestock services.

Ethiopia

Alemu et al (2008) describes the biosecurity of the backyard poultry production system (Sector 4) as very poor and risky, since scavenging birds live together with people and other species of livestock. Poultry movement and droppings are very difficult to control and chickens freely roam in the compounds used by households and children. There is no practice (even means) of isolating sick birds from the household flocks, and dead birds could sometimes be offered or left for either domestic or wild predators. Chickens and eggs are sold on open markets along with other food items. The current live bird marketing system displays significant and potential hazards to people (including buyers) that come to such places, indicating that the implementation of biosecurity and hygienic practices in such a system is generally difficult. The experience from Newcastle disease in endemic countries and the attitude of communities in handling sick birds (most prefer to sell sick ones) shows that marketing systems played a considerable role in the dissemination of the disease in wide geographic areas in a relatively short period of time (Gebreab, 1995). The first record of Newcastle disease was in 1970 on a poultry farm near Asmara, Eritrea, from where it spread all over Ethiopia within a short period of time. In summary, it is very difficult to apply health and biosecurity measures on full day scavenging birds in small flock sizes.

In the case of breeders, successful attempts aimed at the rehabilitation of the centers have been made during the last 6 months along with significant improvement in biosecurity. Some of the improvements made include strict/strong sanitary measures, regular vaccinations, heavy disinfections, controlled movement of the flock and employees, strengthened sanitary facilities (foot bath, incinerators, fumigations etc.), cleaning wild bird nests, close observations and chasing of wild birds etc. Currently there are no disease conditions encountered and the mortality rate of the baby chicks is reported to be very low, except in the case of Mekele, where the rate of mortality of the imported RIR baby chicks is relatively higher. The lack of a feed processing plant and Surveillance and Diagnosis facilities at the Mekele center and the dependence on Debre Zeit for mixed feed supply further complicated the situation. Imported chick mortality is lowest at the Kombolisha center. The center reported to have purchased a vaccine against Gumboro disease that could adequately cover the productive life of the currently imported chicks. The biosecurity status in many of the intensive poultry farms (Sector 3) is extremely poor (Wossene, 2006). The management and health care practices are generally inadequate in view of ensuring prevention against the introduction of HPAI as well as in containing the disease in times of outbreaks. 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 sourcing, handling and storage of poultry products in supermarkets are some of the issues that require utmost considerations and clearly elaborated policy decisions with emphasis on biosecurity aspects.

Ghana

According to Aning et al (2008), poultry producers in Ghana do not seem to practice sound, high biosecurity measures on the farm or at live bird markets. In some sectors, biosecurity is practiced at a minimal to moderate level.

For breeders and hatcheries in Ghana, biosecurity practices are fair to moderately high. There is the possibility of contact with wild birds and other domestic birds because of the free movement of inputs, or birds in and out of the poultry farm. 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 of non-hatching eggs, unhatched eggs, culled chicks, and contaminated packaging materials.

In the case of commercial poultry farms, biosecurity practices are inadequate to low. Working personnels do not wear protective clothing and footwear; farmers rely on public transport for moving birds (including day-old chicks (DOCs)) and eggs and the vehicles used to transport birds are not cleaned or sanitized. Producers have adequate access to vaccination and veterinary services provided by private practitioners or by the government. The system is not well organized, with about 80% of total commercial poultry farms purchasing inputs such as DOCs, feed, and drugs from different suppliers; thus, there are no restrictions for entry or exit of inputs and birds. With free movement of birds from farm to market, contact with wild birds and other domestic birds are most likely to happen. Moreover, most of these farms do not have appropriate manure nor dead birds disposal system.

For the backyard/village poultry farms (sector 4), there is no biosecurity system in place and because of the free-movement of poultry in their environment, contact with wild birds and other animals are highly likely to happen. Manure is disposed of just outside the farm, which is quite risky because one gram of contaminated manure can contain enough viruses to infect one million birds. Producers tend to have access to vaccination provided by the government veterinary services.

Kenya

Biosecurity systems in Kenya are also variable in different farms, but generally the following practices are in place in some large poultry farms (Omiti and Okuthe 2008):

- Visitors are not allowed beyond the office; if one must go beyond the office, they must shower and wear gum boots and dust coats; visitors who have visited poultry farms for the last 24 hours are not allowed
- At the gate, there are tire dips and spray systems for vehicles; foot baths are also available
- Workers upon reporting to the farms must shower and put on clean uniforms.
- Routine cleaning and disinfection of equipment
- Sanitary gaps of 3 weeks – 6 months
- Separate workers and equipment for each units
- Rigorous cleaning, disinfection and fumigation of houses and equipment upon end of the cycle
- Incinerators and burial pits are available to dispose of carcasses
- Houses are bird proof
- Restricted entry and exit of materials/birds in and out of the premises
- Birds from commercial systems can sometimes mix with backyard birds. The occasional sale of birds from subsistence farms involves little or no additional marketing cost (Omore, 2001), and thus may promote the spread of HPAI.

Nigeria

As in the other study countries, biosecurity measures in Nigeria vary across the four poultry production systems (sectors 1-4). Generally, Sectors 1 to 3 practice at least one of the following measures (Obi et al 2008):

- Perimeter fence-guard
- Movement restrictions
- Hygiene of personnel/staff not practiced by 70% of the poultry farms
- Disinfection of containers, vehicles, and other equipment used to transport birds is practiced by about 20-30% of the poultry production units
- For large commercial farms (sectors 1 and 2), entry and exit of materials/birds in and out of the premise are restricted; most equipment and packaging materials in the case of hatcheries are cleaned and sanitized; DOCs are imported from reliable exporting companies
- Large commercial farms and some small ones use all-in-all-out flock management system
- Disposal of non-hatching eggs, unhatched eggs, culled chicks and contaminated packaging materials, biological wastes are not yet well-developed—dumping of wastes is commonly practiced.

In the study countries, the majority of poultry producers still maintain small flocks, which are kept free-ranged and are exposed to outside influences. Most of these backyard flocks are kept by poor farmers for subsistence purposes or as a source of income. At the same time, these small backyard producers may be interspersed with large-scale commercial operations, often, which use high levels of biosecurity to prevent the introduction of disease.

Resource constraints at the farm and intrahousehold level and in veterinary services in developing countries might prohibit the adoption of control measures used in developed countries, 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 supporting smallholder livelihoods. 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. The effectiveness and efficiency of control and prevention strategies are likely to vary significantly across production units depending on their flock size and levels of biosecurity.

4. Threats and Incidences of Hpai in the Study Countries and Institutional Response Capacity

Incidences of HPAI outbreaks in the world have been continuing since the first confirmed outbreak in 2003. The virus is still circulating as a zoonotic human threat posed by the HPAI H5N1 virus and remains a threat to public health. In 2006, a total of 47 countries had reported HPAI in their domestic poultry with repeated outbreaks in Bangladesh, China, Thailand and Vietnam. It is considered endemic in several countries including Egypt, Indonesia and Nigeria. 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.

The occurrence of H5N1 in domestic poultry and in wild birds, with human infections and fatalities, is viewed as an unprecedented epidemiological occurrence. However, the size of the HPAI epidemic in poultry has increased only marginally in terms of numbers; the increase in its geographic spread over the last several years has been substantial. The impact of this spread to humans is unclear but the potential effects are a serious threat to public health. HPAI does not replicate efficiently in humans, although some subtypes of AI can replicate within the human respiratory tract and can cause illness. Most cases of human infection involve close contact with infected poultry, especially ill or dying birds, and have affected people who work with poultry. Part of the problem is that even if the birds survive an initial attack of HPAI, they can pass on the virus from 10 days and up, even without visible symptoms. During this period, unsuspecting bird handlers, farmers, veterinarians, and the general public may become exposed to the HPAI virus.

Although there have been few cases of HPAI in humans and the incidences have decreased since the first half of 2005, the geographic distribution of human cases has increased, along with the number of countries having HPAI epidemics in domestic poultry. As of June 2008, there were 15 countries that had reported human infections, including two of the study countries: Indonesia and Nigeria. Both Indonesia and Nigeria have also reported human fatalities (Table 12). In most outbreaks that have occurred, there have been approximately one human case for every 30 avian outbreaks, the exception being Cambodia. This estimate provides a crude measure of how efficiently the virus infects humans. The actual risk may deviate significantly from this estimate because of substantial variations in outbreak size, surveillance practices, and animal husbandry.

What follows is a brief account of the number of HPAI outbreaks and the preventive and control measures taken by the government and private sectors to mitigate the risk of introduction and/or spread of HPAI (summarized in Tables 12 and 13). A full description of the confirmed outbreaks and institutional responses is reported in the annexes to this synthesis background paper. This could serve as baseline information for assessing current institutional responses and preparedness activities, constraints and needs of each of the study countries.

Incidence of HPAI outbreaks in Nigeria and institutional response capacity to prevent and control HPAI

Most of the reported outbreaks in West Africa have occurred in domestic poultry, mainly in commercial operations. The virus was reported for the first time in Nigeria in January 2006 in Sambawa, Kaduna and was confirmed a month later (Table 12). Two months later, the disease had spread to 11 states and by July 2006, there were 14 states and the Federal Capital Territory (FCT) that were confirmed as infected with HPAI. These states were Kaduna (Igabi, Kaduna- North, Kaduna-South ,Sabongari and Chikun); Kano (Kumbotso, Janguza, Nasarrawa and Gezawa); Jigawa (Hadejia); Plateau-Muncipal and Bwari; Nasarawa (Kokona and Akwanga); Benue (Oturkpo); Anambra (Idemili-South); Lagos (Agege, Ojo,Ikorodu, Alimosho); Taraba (Ibi); Rivers (Portharcourt); Ogun (Ifo) and Yobe (Nangere).

Table 12 Status of HPAI in the study countries, and number of confirmed outbreaks and human cases of HPAI (H5N1) reported to the WHO (as of June 2008)

	Number of outbreaks (by state/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

Source: http://www.oie.int/wahid-prod/reports/en_fup_0000006800_20080215_130346.pdf
*Note: Data on culled birds shown reflect estimated data for 2004 and 2006 only. Hartono (2004) indicated that between July 2003 until January 24, 2004 when the outbreak took place a total of 15 million layers, 2 million parent stock and 86,000 broilers died or were slaughtered.

In response to the first confirmed outbreak, an Avian Influenza Crisis Management Centre (AICMC) was created to coordinate activities and disseminate information on the prevention and control of HPAI. Three committees were set up in the AICMC: the Steering Committee, Technical Committee, and Communications Committee, jointly chaired by the ministers of the Ministry of Health (MoH), the Ministry of Agriculture and Water Resources (MoAWR), and the Ministry of Information and Communication (MoIC) (see Figure 7.3 in Annex V for the working structure of HPAI management). The MoAWR is responsible for all related issues pertaining to animals and their diseases, including poultry. Under the MoAWR is the Department of Livestock and Pest Control Services (FDLPCS) that heads the Veterinary Services at the federal level.

The FDLPCS established five units for HPAI prevention and control, namely the Epidemiology, Containment, Compensation and Restocking, Logistics and Communication units. The Epidemiology unit, which incorporates the National Animal Disease Information and Reporting System (NADIS), is responsible for HPAI disease investigation, international liaison, post-containment investigations, training, and laboratory diagnostic laboratory coordination. The Containment unit handles issues relating to depopulation, carcass disposal, decontamination, quarantine as well as movement control. The Compensation and Restocking unit prepares compensation guidelines as well as pays out compensation and handles issues related to restocking. The Logistics unit oversees supplies of items needed for containment of the disease, including ground support, and the Communication unit handles the public awareness campaign and media coverage of HPAI control efforts.

The United Nations system and international development partners in Nigeria were also involved in providing a) technical and financial support in the development of a communication strategy and action plan for HPAI and the human pandemic; b) technical support and materials for the containment and decontamination to the government of Nigeria; c) laboratory equipment and reagents to the National Veterinary Research Institute (NVRI), Vom; d) organization and funding of training workshops for field as well as laboratory staff in various aspects of H5N1 diagnosis and HPAI containment and control. As a result of the efforts to upgrade the capacity of NVRI's laboratory equipment and staff, NVRI has been designated as the regional laboratory for HPAI and other transboundary animal diseases for West and Central Africa. The government is also making efforts to upgrade the diagnostic capacity for the H5N1 virus with five Veterinary Teaching Hospitals in Zaria, Ibadan, Nsukka, Maiduguri and Sokoto Universities.

To date, there are 25 states and the FCT that have been confirmed as infected with the HPAI virus. These states are Adamawa, Anambra, Bauchi, Benue, Borno, Edo, Enugu, Kaduna, Kano, Katsina, Kwara, Lagos, Nasarawa, Niger, Ogun, Oyo, Plateau, Sokoto, Rivers, Taraba, Yobe, Zamfara, Ekiti and the FCT. The last confirmed outbreak of HPAI occurred in the town of Nsugbe in Anambra-East LGA of Anambra states on October 6, 2007.[5] As of May 2008, approximately 1.3 million birds had been depopulated as part of HPAI control measures.

[5] A new HPAI strain has been identified recently (August 2008) in Kano and Katsin that is different from what has been circulating around in 2006 and 2007 outbreaks but more similar to the one identified in Europe (Italy), Asia (Afghanistan) and the Middle East (Iran) in 2007. It is possible that the

Incidences of HPAI outbreaks in Ghana and the institutional response capacity to prevent and control HPAI

In Ghana, there were three cases of H5N1 HPAI outbreaks that were detected between April 2007 and June 2007 (Table 12). The first one detected was in a small-scale poultry farm in Kakasunanka, located within the Tema Metropolitan area of the Greater Accra Region. Another outbreak was confirmed in a backyard poultry farm in Asuokwa, New Dormaa in Sunyani in Brong Ahafo. The third outbreak occurred in Aflao, in the Ketu District of the Volta Region. Bans on the movement and sale of poultry and poultry products in the outbreak area were implemented. A total of 27,358 birds were culled from poultry farms within the 3km radius (which was later on extended to 5km and then to 8km) of the infected area (Table 12). In addition to banning the movement of poultry products and depopulation, the Ministry of Food and Agriculture also imposed the closure of wet markets in the infected areas, quarantine of the infected farms, active search for the disease in the area and around the premises, and disinfection of infected premises and farm machinery and equipment (Table 13).

Prior to the first outbreak, the government of Ghana had put up an Avian Influenza Working Group for HPAI management. This working group was formed to take charge of the coordination of plans and actions to address the threat of an AI pandemic. The group was expanded after the first outbreak to include representatives from the Veterinary Services under the Ministry of Food and Agriculture (MOFA), Ghana Health Services under the Ministry of Health (MOH), Wildlife Division under the Ministry of Lands Forestry and Mines (MLFM), University of Ghana, National Disaster Management Organization under the Ministry of Interior, and international development partners (FAO, WHO, USAID, UNICEF, UNDP), and non-government organizations. These institutions have their respective roles in managing HPAI preventive and control measures. For example, the Veterinary Services is in charge of managing the prevention and control of AI in poultry and poultry products and conducting diagnostic tests; the Wildlife Division is in charge of the surveillance of HPAI in migratory and non-migratory wildlife birds; and development partners provide financial support and technical assistance.

To date, there have been no further reported outbreaks after the three outbreaks that occurred in 2007. However, the country remains to be in a state of alert because of the circulation of the virus in West Africa, given the repeated outbreaks in Nigeria in January 2006- October 2007, and in Benin in November –December 2007. In addition, the source of the HPAI virus that infected the poultry farms is still unknown.

virus was introduced through international trade or illegal and unreported movement of poultry. The channel via migratory birds for the virus getting into the country seemed to be unlikely since the last migration of wild birds from Europe and Central Asia to Africa occurred in September 2007 and this year's southerly migration into Africa has not really started yet (FAO Newsroom August 11, 2008, accessed at http://www.fao.org/newsroom/en/news/2008/1000909/index.html).

Incidences of HPAI outbreaks in Indonesia and the institutional response capacity to prevent and control HPAI

HPAI due to H5N1 broke out in Java in August 2003 and has spread to many different parts of the country, probably through the movement of poultry. Some 10.5 million birds in 2004 and approximately one million birds in 2006 died due to HPAI infection (Table 12). As of June 2008, the disease has infected poultry including chickens, quails, and ducks in 31 out of 33 provinces and in 286 out of 444 districts all over the country. Incidences vary across the country with lower incidences in the eastern provinces, but the differences could be due to limited surveillance or lack of reporting. At present, HPAI is considered to be endemic in Java, Bali, Sumatra and South Sulawesi, affecting both commercial and backyard/village poultry farms and in areas where farming and animal husbandry are the main means of livelihood and poultry are mostly raised for domestic consumption. In all other areas in Indonesia, HPAI is considered sporadic.

The first human case of H5N1 influenza in Indonesia was reported in June 2005. By the end of 2005, there were 20 human cases reported, 13 if which were fatal. The highest number of human deaths recorded so far was in 2006 with 45 fatalities out of 55 human cases. As of June 2008, out of 135 human cases reported, a total of 110 have been fatal (WHO 2008)[6]. The latest human cases reported in 2008 occurred in West and Central Java, DKI Jakarta, and Banten provinces, and happened not only in rural areas but also in urban areas. Investigations into the source of the infection indicate exposure to sick and dead poultry.

After the large outbreaks that hit the country in 2003-2004, the government of Indonesia acknowledged the emergency nature of HPAI outbreaks and created a National Commission on Avian Influenza and Pandemic Disease to manage HPAI outbreaks and issued the Presidential Instruction 1/2007 on Handling and Controlling of Avian Influenza Virus (see Annex Figure 4 in Sumiarto and Arifin 2008, Annex III). Sumiarto and Arifin (2008) noted that the National Commission had formulated six strategic steps to handle the HPAI pandemic in Indonesia: (a) information dissemination, communication, and education, mostly focused on HPAI responsive strategy; (b) restructuring livestock industry, improving biosecurity and certification for commercial farms, enforcement of poultry slaughterhouses and other slaughter places; (c) integrated epidemiologic surveillance, including the expansion of participatory disease surveillance (PDS) and participatory disease response (PDR); (d) handling virus at the source through biosecurity, vaccination, culling and compensation, including pre-cautious culling when involving human death; (e) improvement and empowerment of health service, including human vaccine and capacity building for the health service staffs; and (f) preparedness and pandemic simulation, especially in regional and local hospitals.

These actions are commissioned by the National Commission on Avian Influenza and Pandemic Disease and implemented by both central and local government coordinated by the Ministers of the Ministries of Social Welfare, Finance, Agriculture, and Health.

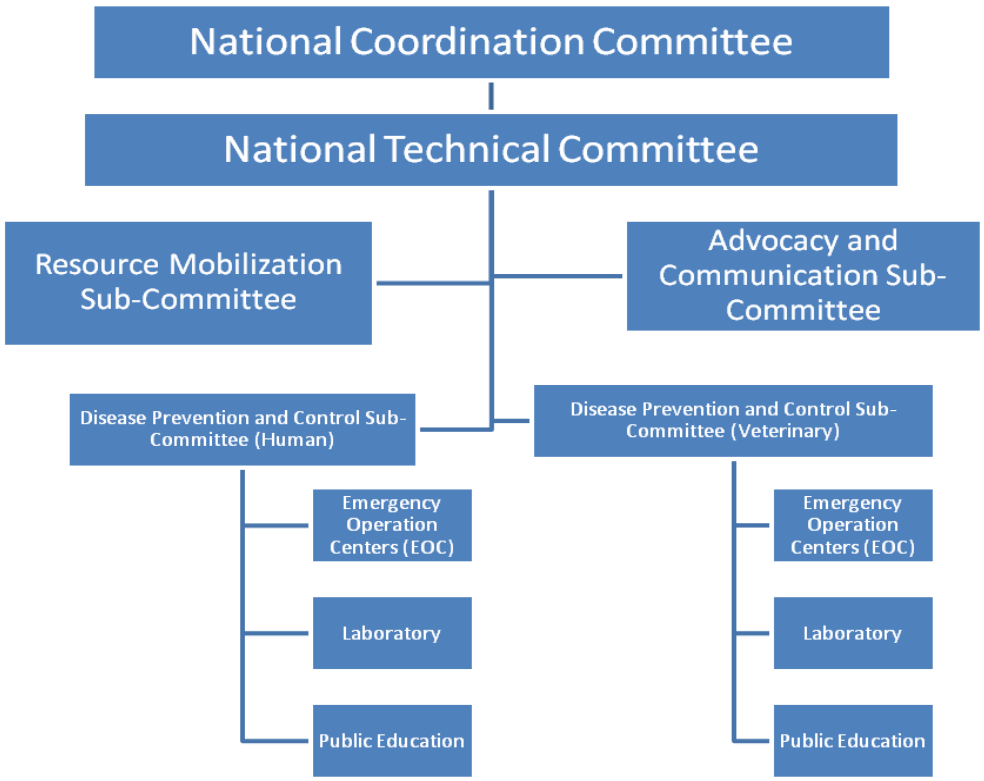
[6] WHO's situation updates on AI; accessed on July 31, 2008 at http://www.who.int/csr/disease/avian_influenza/updates/en/index.html,

Incidences of HPAI outbreaks in Ethiopia and the institutional response capacity to prevent and control HPAI

At present, Ethiopia is a HPAI-free country but the risk of HPAI entry into the country cannot be understated. Ethiopia, along with other east African Rift Valley nations, such as Kenya, Tanzania, and Uganda, are considered at high risk for the spread of the virus, as millions of migratory birds flock there during the European winter. Moreover, two of Ethiopia's bordering countries, Sudan and Djibouti, have already been infected by HPAI H5N1 (Alemu et al. 2008). The movement of infected birds or contaminated equipment across these borders could contribute to the risk of the spread of HPAI. Another threat of HPAI was the incidence of high mortality rate of chickens at the breeding and multiplication center in Gurage in 2006 suspected to have been infected by HPAI virus but was tested negative. This suspicion triggered scare and panic among the general public and thus required immediate response. The government mobilized its awareness campaign to inform the public of the risks of inappropriate handling of sick and dead birds, and provided safety measures to avoid infection.

The government also established a National Coordination Committee (NCC) to coordinate the prevention and control strategies in case of an HPAI outbreak in the country. Under the NCC is the National Technical Task Force composed of four sub-committees: resource mobilization, advocacy and communication, human prevention and control (headed by the Ministry of Health), and veterinary prevention and control (headed by the Ministry of Agriculture and Rural Development) (Figure 11). The NCC is also responsible for setting up a three-year emergency preparedness and response strategic plan for avian influenza pandemic threat. The strategic plan aims to prevent the introduction of the disease through appropriate quarantine and import control of poultry and poultry products; to detect the disease as early as possible; to contain and eliminate the disease before it spreads to other parts of the country; and to ensure effective communication mechanisms and strategies with stakeholders and communities. In the case of an HPAI outbreak, the mitigation strategies to be implemented include stamping out within the 3km radius of the infected area; disposal of carcasses and contaminated material, cleaning and disinfection of contaminated premises; movement control of poultry and poultry products including market closure within 10 km radius of infected site; blanket vaccination in high risk areas or ring vaccination within 5 km radius from the external perimeter of stamping out area; intensive surveillance and diagnosis; and compensation (MoARD and FAO 2006; Table 13).

Figure 11. Organizational structure of the National Coordination Committee involved in HPAI management in Ethiopia



Source: AHI National Technical Committee 2006.

Incidences of HPAI outbreaks in Kenya and the institutional response capacity to prevent and control HPAI

As in the case of Ethiopia, there are no cases or incidences of an HPAI outbreak in Kenya based on active and targeted surveillance carried out in different parts of the country. The major threat of the introduction of HPAI was during the outbreak of avian influenza in Khartoum and Juba in Sudan in September 2006. Since Kenya and Sudan share a common border, there is a high risk of transmission of the HPAI virus into Kenya through legal and illegal trade of poultry and poultry products. The government imposed import bans on poultry and poultry products from HPAI infected countries, strengthened controls in cross border trade, and conducted passive and active surveillance in domestic and wild birds.

As a response to this threat, the government has set up a multi-sectoral task force to prepare and coordinate avian flu preparedness and a response plan. According to Omiti and Okuthe (2008), the task force is headed by the Ministry of Livestock and Fisheries Development (MoLFD) and the Ministry of Health (MOH). The task force is composed of representatives from development partners (FAO, WHO, CDC, WB, UNDP, USAID, UNICEF, ILRI, AU-IBAR), non-government organizations, civil societies, universities (University of Nairobi), and stakeholders in the poultry industry. Other stakeholders that took part in the planning process include the Ministry of Special Programmes – Office of the President, Ministry of Finance, Ministry of Tourism, Ministry of Forestry and Wildlife, Department of Immigration, National Museums of Kenya (NMK), Kenya Red Cross Society, Walter Reed

Project, Sanofi Pasteur, Centre for Virus Research – Flu surveillance Network, and Kenya Wildlife Services.

The task force consists of six sub-committees: epidemiological surveillance; laboratory and research; infection prevention and control; case management; information, education and communication; and coordination and resource mobilization. The task force established a National Action Plan that covers both animal and human health aspects of prevention and control measures in case of an HPAI outbreak. The animal health component has an elaborate surveillance network comprising both the public and private veterinarians and other stakeholders, including livestock keepers and traders as part of the country emergency preparedness programme for major transboundary animal diseases.

Omiti and Okuthe (2008) noted that upon confirmation of an outbreak of HPAI in the country, MoLFD's Department of Veterinary Services (DVS) shall convene the Crisis Management Team (CMT) as soon as possible. The CMT shall mobilize the Rapid Response Team, both national and local, to implement disease control measures like culling, disposal, quarantine enforcement and maintenance of public order.

Measures taken to prevent and control HPAI in the study countries

Table 13 summarizes an overview of the state of responses and preparedness activities to avian influenza threats by both government and private sectors in each of the study countries. The national plans developed by the governments of each of the study countries have focused on the following action areas: (a) the improvement of animal health, (b) functioning veterinary and human health systems, (c) coordinated action for pandemic preparedness and (d) social mobilization and communication. In some cases, there have been significant enhancements in avian influenza detection capacity, surveillance and reporting systems, animal disease controls (transboundary including AI), and compensation arrangements.

Table 13. Control measures and responses of governments and private sectors to HPAI outbreaks in the five study countries

	Responses of Governments	Responses of private sectors	Control Measures
ETHIOPIA	Established a national task force, which set up technical committees Drafted a US $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	Individuals importing the food are responsible for ensuring compliance with food safety from the country of origin. Exporters are also responsible for ensuring compliance of goods with food safety standards, quality and nutrition.	Banned all poultry imports and poultry machinery from countries with HPAI outbreaks Strengthened controls on cross border trade
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 importation of contaminated poultry products in the spread of AI Sero-surveillance/epidemio-surveillance (active and passive search for the disease in the infected area and beyond) established	Anecdotal information suggests that some farmers folded up their businesses due to inability to market products because of the ban on the sale of poultry and poultry products	Quarantine of infected farms and standstill measures as required Ban on the movement of poultry and poultry products in and out of the 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	Established a national committee, Komnas FBP, on Avian Influenza to ensure AHI strategy implementation Engaged non-government organizations and civil society in planning Komnas FBP, with support from UNICEF in coordination with FAO and AED, and the Ministries of Health, Agriculture and Information launched a separate national public awareness campaign to promote behavior change and to raise awareness to reduce the risk of human exposure to HPAI A US$15 million World Bank grant to control avain flu and provide preventive vaccines and compensation for culling Implemented standard procedures and systems for communicating outbreak observations and reporting between the government and technical agencies and hospitals Implementation of compensation policy for culled poultry	Implemented standard procedures and systems for communicating outbreak observations and reporting between the government and technical agencies and hospitals Launched a national public awareness campaign to promote behavior change and to raise awareness to reduce the risk of human exposure to HPAI	Selective Stamping out Selective Vaccination Surveillance Compensation to layer farms with less than 10,000 hens and broiler farms with less than 15,000 bird per cycle Credit schemes for farms that have been 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	Completed a national action plan Strengthened surveillance Launched awareness programs	Farmers reduced the size of their poultry flock for fear of the avian flu, lack of market for their products and low	Epidemio-surveillance (includes both active and passive surveillance)

	Placed veterinary personnel at entry points on alert Training of 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 Increase awareness among small-scale farmers and poultry producers	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 to contract avian flu. Sector 1 and 2 suffered losses as a result of cancellation and reduced booking for day-old chicks. Peoples' attitudes towards chicken were greatly affected by the initial announcements about avian flu from the media. However, after a short period, they recovered from the shocks through public awareness campaigns aimed to enlighten individuals about the spread and nature of the disease	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	Putting plan in place for restocking poultry once bird flu outbreak is confirmed The UNCT established a national task force and committees at the state level to assist government in preparedness and response Government established a Crisis Center to link with affected areas Teams from FAO, WHO and US Centers for Disease Control and Prevention training Nigerian health and veterinary workers in controlling the virus Engaged non-government organizations and civil society in preparedness and planning Conducted socio-economic impact studies of HPAI	Through the Community Dialogue System (CDS), community leaders were trained in identifying risky behaviors, attitudes, perceptions and beliefs, before, during and after the outbreaks	Quarantine Eradication Restocking poultry once bird flu outbreak is confirmed Compensation to farmers whose birds were destroyed, at 30-40% of the market value

Sources: United Nations Office for Coordination of Humanitarian Efforts (2006). http://www.irinnews.org/frontpage.asp; Alemu et al. 2008; Aning et al. 2008; Sumiarto and Arifin 2008; Omiti and Okuthe 2008; Obi et al. 2008.

Effectiveness of current policies, laws, and regulations implemented

The effectiveness or success of implementation of existing policies, laws and legal and regulatory systems related to the poultry sector and HPAI depends on the following factors: a) a strong commitment in the efforts against AI to ensure their implementation at the highest political level, accompanied by effective leadership of all concerned stakeholders; b) clear procedures and systems for managing the rapid implementation of priority actions; c) primary attention to 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 (including restriction of movement of animals that are at risk); d) incentive and/or compensation schemes combined with effective communication to communities on the importance of immediately reporting disease outbreaks in animals to responsible authorities; e) effective mobilization of civil society and the private sector; f) national mass communication campaigns that promote healthy behavior and focus on reducing the extent to which humans might be exposed to HPAI viruses (UNSIC and World Bank 2006).

In all of the five study countries, the rapid response to HPAI by setting up the inter-sectoral national task force, the frequent meetings of this task force, and the governments' financial support to put the strategic plans into action indicate a strong political commitment to ensuring HPAI strategy implementation. Each of the national task forces has established a sub-committee for communications to raise public awareness to reduce the risk of exposure to HPAI, and on the importance of disease outbreak reporting. Table 14 shows experts' opinions on the effectiveness of selected preventive and control measures implemented in each of the study counties.

Table 14. Effectiveness of preventive and control measures in reducing the risk of HPAI outbreaks

Control measures	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 industrialized sector and large commercial poultry farms

Alemu et al. 2008; Aning et al. 2008; Sumiarto and Arifin 2008; Omiti and Okuthe 2008; Obi et al. 2008.

Identified constraints/challenges hindering effective control and mitigation of the disease

Several constraints that impede the effectiveness of implementing control strategies have been identified. Among these constraints are a lack of funding to put plans into action, inter-sectoral coordination, restructuring of the poultry industry, and regulatory framework for biosafety without negatively affecting the livelihoods of poor and backyard farmers.

For example, Sumiarto and Arifin (2008) noted that the main constraints that hindered the success of the vaccination program in Indonesia were: a) decentralized veterinary authorities in provincial and district levels; b) low vaccination coverage due to the wide areas to be covered, extensive production systems (free-ranging so it was difficult to catch for vaccination); c) various species infected; d) limited human resources; e) limited access of backyard farmers to government veterinarians; low operational budget available; and f) low bio-security at markets, slaughter houses and small-scale and backyard farms including

handling and disposal of dead birds and manure. Moreover, the vaccination policy was not transparent and the vaccines used were not standard.

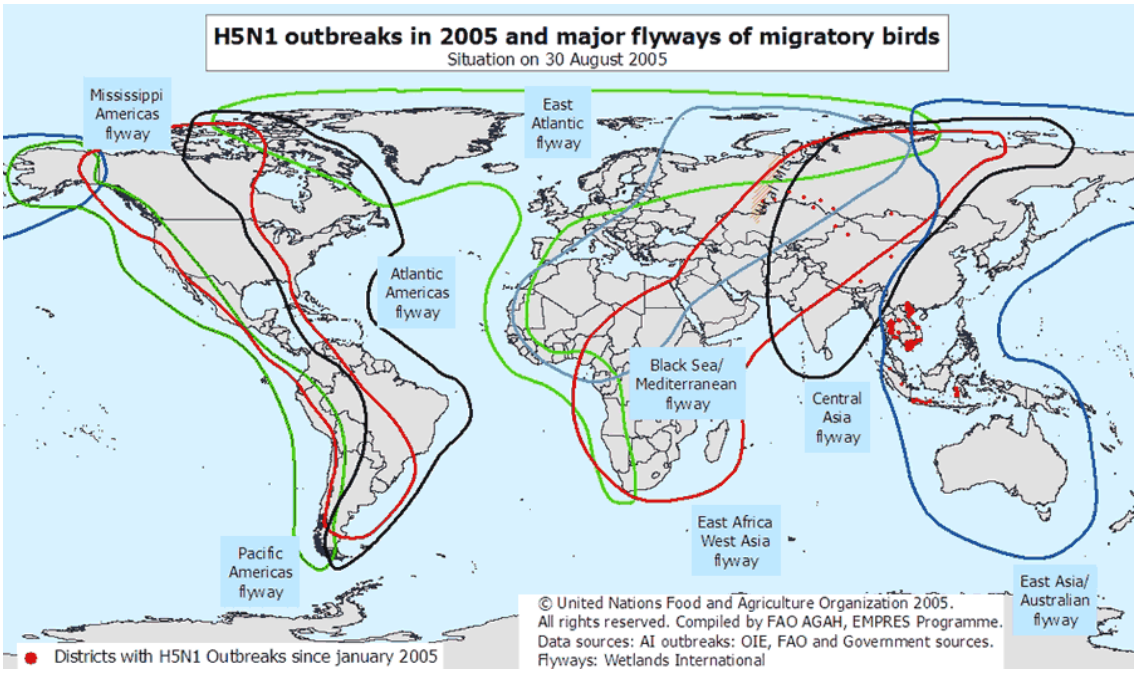
In Kenya, some of the constraints to disease reporting and early detection of the HPAI identified by Omiti and Okuthe were lack of information on breeding practices and sources of different breeding materials in the backyard systems and the role of private animal health service. In the case of their vaccination plan, the problem identified in this strategy is the poor delivery system of vaccine to the end users.

5. Current Knowledge Regarding the Spread and Impact of Hpai on the Poor in Study Countries

Relevant information on risk factors for entry and spread of HPAI in the study countries

Several channels of HPAI virus introduction have been identified and could most likely increase the risk of spread into countries not infected with the virus yet. One of the potential risk pathways of HPAI virus introduction is the migration of water birds. It provides a complex network because different bird flyways overlap geographically; for example, Alaska has four overlapping major flyways creating a crossroad for many species: East Asia/Australasia, Central Pacific, Pacific Americas, and Mississippi Americas (Figure 12). Birds infected with the HPAI virus can shed the virus for up to one month. Birds from different regions intermingle with each other in areas where large bodies of water attract them, and transmission of viruses can occur between them. The outcome is that potentially viruses can be transmitted from infected countries in Southeast and East Asia to Central Asia, Eastern Europe, the Middle East and Africa, and North and South America. In the course of the current epidemic, a large number of wild bird species have been found dead, with the AI virus type H5N1 isolated. Recent findings show that the virus can be isolated from other bird species without signs of disease. However, it is not yet fully determined which species are implicated in the long distance introduction of the virus and its transmission to poultry, as in the case of West Africa where the role of wild migratory birds in the transmission of HPAI virus is still unclear.

Figure 12: H5N1 Outbreaks and Major Migratory Flyways



Some evidence also suggest that domestic ducks could play a key role in the pathogenesis and spread of HPAI H5N1 virus because of the shared environment by ducks and poultry, particularly at the village level (where free-range poultry raising is very common) and in some poultry live markets.

Another potential pathway of HPAI introduction is through legal and illegal trade of poultry and poultry products. As observed in Asia, poultry trade has played and continues to play a major role in the secondary spread of the disease. In Africa, the introduction of the disease through illegal trade cannot be excluded. It is observed that informal movement of birds across borders is very difficult to monitor and thus holds huge risks of disease transmission. The introduction could happen through illegal importations of live poultry or more likely poultry products that have been infected with AI, or fomites through contaminated vehicles, containers, and so on. In West Africa, for example, the countries at immediate risk of infection are those sharing borders with Nigeria, namely Niger, Benin, Chad, and Cameron. Illegal movement of live birds also represents a risk that will not be mitigated by imposing bans on legal importation.

Ethiopia

Ethiopia is considered at risk for HPAI introduction because of its geographical location (through wild migratory birds) and its potential commercial links with other countries (through legal and illegal trade of poultry and poultry products. Legal trade of DOCs is carried out by large commercial farms and state-owned multiplication centers from Egypt, Germany, Holland, Kenya, Saudi Arabia and the United Kingdom. Ethiopia stopped imports of DOCs from Egypt, Germany and the United Kingdom after the outbreaks were confirmed in these countries as recommended by the World Organization for Animal Health (OIE). Based on the results from the quantitative risk assessment conducted by Magalhaes et al. (2006), the risk of HPAI introduction via legal trade of DOCs into Ethiopia is very low, but likely to occur.

The risk of illegal cross-border trade of live poultry from infected zones like Djibouti and Sudan into Ethiopia should also be considered a potential risk of HPAI introduction. Demand for poultry via this route is high and prices are more competitive (FAO, 2006a). In the case of wild migratory water birds, results from the qualitative risk assessment suggest that the probability of the introduction of the H5N1 HPAI virus into Ethiopia is null to low (FAO 2006b).

Ghana

In the case of Ghana, the wild migratory birds' flyways relevant are the East Atlantic and Mediterranean flyways. The coastal wetlands are the staging posts for wild migratory birds in Ghana. The migratory wild birds considered to be highly susceptible to HPAI include ducks, geese, swans, gulls, waders, and terns (Aning et al 2008). So far, there is no information that is readily available on the route of the migratory wild birds and their contact with local water wild birds/domestic fowls within Ghana. Likewise, wild in the case of non-migratory bird species, there is no documentation of virus activity or prevalence of HPAI in local birds in Ghana, except for vultures and hawks, but none on local water wild birds.

Legal trade of live poultry could also be considered as a risk factor in the introduction of HPAI. A major concern in terms of trade is the flow of imported poultry products such as DOCs and hatching eggs to the north-south trade, that is, from Accra to Kumasi and to neighboring cities or districts, which could be a potential pathway for the spread of HPAI. Cross border trade (e.g., along Ghana and Cote d'Ivoire border) of live poultry and poultry products (eggs and frozen meat) without permission from concerned government authorities are also potential points of entry and transmission of HPAI virus. It is even difficult to control movement of poultry and poultry products along the border especially when poultry producers have farms on both sides of the border. Another source of in virus

infection would be through mechanical transmission such as contact of contaminated vehicles and containers used to transport infected birds that have not been cleaned and disinfected.

Nigeria

Some of the major research efforts on HPAI in Nigeria have been in the following areas: i) H5N1 surveillance in wild-birds in wetland areas in Northern Nigeria; ii) Avian Influenza National baseline survey, iii) socioeconomic analysis of the impacts of HPAI on households' poultry consumption and the poultry industry, and iv) isolation and molecular characterization of H5N1 viruses from poultry in Nigeria. An active HPAI disease surveillance as well as H5N1 virus surveillance in selected live bird markets have been done while an FAO funded study on the role of wild-birds, wetlands, domestic ducks and Floodplain Agriculture in the introduction, spread and persistence of the H5N1 virus in Northern Nigeria was carried out recently. Gaps that have been identified include the role of indigenous poultry breeds and resident wild birds such as local domestic ducks, guinea fowls, cattle egrets and vultures in the spread and sustenance of HPAI in Nigeria, the role of live bird markets in the spread and maintenance of HPAI in Nigeria as well as continued active disease surveillance in various poultry production and marketing systems in Nigeria.

Kenya

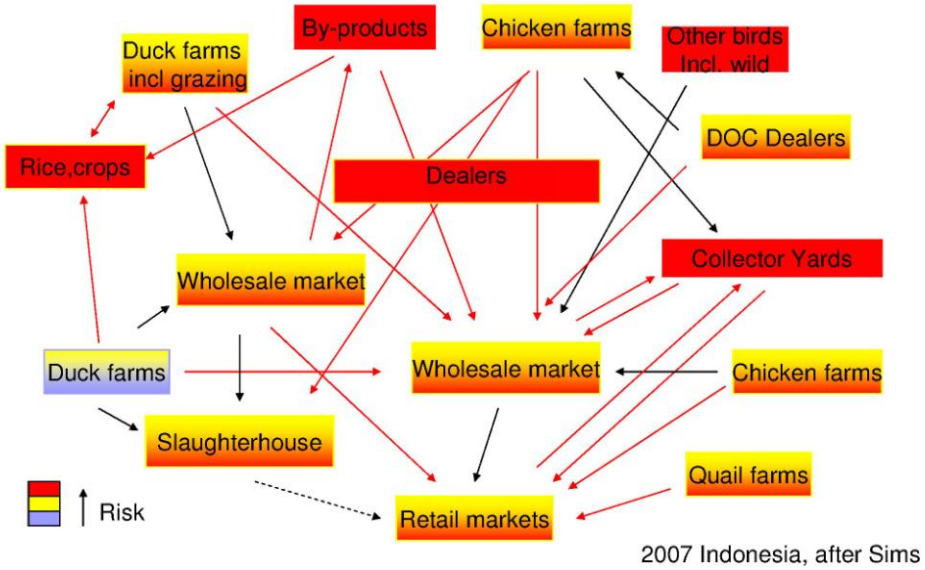
There is a potential risk of introduction of HPAI in Kenya by migratory birds. There is ready interaction between wild birds and scavenging domestic poultry. The high-risk season starts from mid-September to December and after, when birds are arriving from the north in migratory spots.

Indonesia

There is no recent information for Indonesia about the prevalence of HPAI in wild birds except a small scale surveillance carried out in selected parts of the country (APAIR, 2008). Analysis or genetic sequences and other indirect evidence suggest that at least in some cases wild migratory birds are likely to have contributed to further spread in Asia, but in the case of Indonesia, wild birds may play a less important role in spreading avian influenza. The actual importance of this mechanism, however, is unclear in the present state of knowledge.

An illustration of the possible risk pathways for the spread of HPAI into the poultry supply chain (farm to market) through marketing and legal trade in different parts of Indonesia is shown in Figure 13. Buying infected chicken at live bird markets, dealers and collector yards appears to be high risk marketing practices.

Figure 13: Possible risk pathways for HPAI spread within the poultry supply chain in Asia



Source: Adopted from the presentation on "Achievements, issues, and options on strategies for HPAI control and prevention" by L. Sims . Accessed on July 30, 2008 from http://www.authorstream.com/Presentation/Camilla-43921-3-2-ii-Sims-Outbreak-control-lessons-Achievements-issues-options-strategies-HPAI-prevention-Progress-so-far-Why-no-uni-a-o-Education-ppt-powerpoint/

Table 12: Risk factors identified

Risk factors	Ethiopia	Ghana	Indonesia	Kenya	Nigeria
Wild migratory birds	Null to low	Medium	Medium	High	High
Non-migratory birds	Low	Low	Low	Low	Low
Legal imports	Low	Low	Low	Low	Low
Illegal imports/smuggling	High	High	High	Medium	High

Sources: Alemu et al. 2008; Aning et al. 2008; Sumiarto and Arifin 2008; Omiti and Okuthe 2008; Obi et al. 2008.

a. Key stakeholders affected

The evidence collected in the background papers suggest that HPAI is a serious threat to poor rural households since they consider poultry production as an essential economic activity. Mortality caused by HPAI virus infection could directly affect their petty cash income and thus deprive them of the opportunity to escape poverty and food insecurity.

Among the rural poor in the , poultry sector, the traditional or backyard poultry producers are identified to be vulnerable to production and market shocks due to HPAI scare and outbreak (such as significant decreases in production levels and sudden drop in output prices as consumption substantially decline). As described earlier, these producers commonly practice low-input, low-cost poultry production and operate scavenging and semi-scavenging systems. They keep a handful of birds, typically indigenous or local breed chickens, for home consumption and quick cash through local sales. Their sources of livelihoods are quite diverse, thus making them vulnerable to HPAI shocks.

Small-scale poultry producers that practice intensive poultry production and raise poultry mainly for sale and some for home consumption are also considered vulnerable to HPAI shocks. They are vulnerable to the direct impact of poultry deaths from disease or culling (as a control measure) since they are resource poor and have heavily invested in raising poultry. Furthermore, culling measures affect these producers particularly if they have no access to compensation, and thus could force them to abandon poultry keeping. Restructuring the poultry sector would also negatively affect producers who lack the assets to upgrade their production system in terms of biosecurity (as recommended by FAO).

Other groups that are most likely to be affected by HPAI shocks include feed manufacturers and distributors, suppliers of DOCs, small-scale traders, market operators, slaughterers, transporters, and small processors. They are vulnerable to price fluctuations caused by HPAI outbreaks and restrictions or bans imposed across the marketing chain, and shortage of supply of poultry. Price fluctuations could result in decreased and unstable income and a change in consumption patterns. These shocks could also affect the employment of traders, processors, and most especially poultry farm workers.

Other stakeholders that are most likely to feel the impact of shocks caused by HPAI outbreaks are input suppliers such as DOCs due to import bans and movement controls and consumers who would prefer safer food, which restricts market outlets for non-industrial producers.

b. Identified knowledge gaps

In each of the study countries, a number of research gaps have been identified in terms of the current status of knowledge and infrastructure relevant to HPAI and its control and preventive measures. All of the five countries indicated the need for a census of the poultry population, especially the small-scale and backyard poultry farms.

Indonesia

In Indonesia, Sumiarto and Arifin (2008) have identified research gaps related to the epidemiology of HPAI and the economic situation. More research is needed on the a) epidemiology of HPAI and mechanism of spread of the disease on all types of production systems; b) efficient and effective evidence-based control and mitigation measures; c) appropriate monitoring and surveillance

schemes; d) risk assessment and risk mapping; e) perception of the importance and control of HPAI among specific stakeholders (local policy makers); f) economic evaluation of the effectiveness of mitigation measures including compensation schemes, market closure, restructuring, trade restrictions, and so on; and g) impact of regional autonomy on mitigation applied.

Ethiopia

One of the risk reduction strategies suggested by the National Technical Task Force is to practice biosecurity measures in poultry farms all over the country with limited or no biosecurity measures in place. However, there is no recommendation as to what type of biosecurity is economically and socially feasible under the Ethiopian small-scale backyard poultry farming system. Similarly, research has shown that the biosecurity practices in both private commercial farms and government-owned multiplication farms are said to be very low. One reason is that poultry farmers have limited knowledge regarding biosecurity and its importance to poultry production. This is one of the gaps that needs to be addressed.

Another important area that needs further investigation is the quantitative assessment of the risk of introduction of the HPAI virus through illegal cross border trade with neighboring countries. Another priority area is the disease surveillance and diagnostic capacity and responsiveness of the country that has to be improved.

There are also gaps in research of institutional mechanisms for implementation of prevention and control measures in Ethiopia in the case of an AI outbreak and design of an effective risk communication strategy that will provide all stakeholders the correct information they need.

Ghana

Aning et al. (2008) identified the following research gaps: i) a comprehensive census of poultry population and live birds markets with geo-referenced farm locations including mapping of poultry farming systems as a basis for appropriate value chain risk assessment and ii) qualitative and quantitative risk assessment of risk of spread of HPAI H5N1 in Ghana.

Kenya

There is a need to conduct a poultry population census, including data on domestic and international trade, in order to update and validate existing data (the last census on poultry was carried out in 1976). It is also important to evaluate the poultry value chain and identify the critical control points for HPAI entry so as to help design effective control and mitigation strategies. This would include evaluating different marketing channels of poultry and poultry products and the level of awareness of HPAI by different key actors in the chain.

There is a need to promote awareness of HPAI risk among producers and consumers of poultry products in order to reduce their ignorance on disease transmission and therefore avert possible losses due to an HPAI scare. It is also important to determine the factors that affect the effectiveness of risk communication.

The veterinary department should come up with clear guidelines on the appropriate control approaches for the disease (e.g. vaccination and compensation policies). For example, appropriate compensatory mechanisms should be instituted, possibly through poultry insurance schemes in order to protect farmers and businesses in the poultry sector from economic losses associated with an

HPAI outbreak or scare of and outbreak. It is therefore important to evaluate the cost-effectiveness of alternative HPAI control strategies in case of a potential outbreak.

Research is also needed to assess the impact of HPAI on the livelihoods of the poor.

Risk assessment studies should be carried by the DVS as a component of an early warning system to make the risk based surveillance system comprehensive. The lack of documented risk assessments (release, exposure and consequent) results in indecisiveness in applying appropriate disease control strategies. Studies should be carried out to detect an HPAI outbreak at an early stage, assess the levels of biosecurity for different production systems, and better mitigate the consequences of the disease.

Nigeria

In the case of Nigeria, areas that need further research are: a) the role of indigenous poultry breeds and resident wild birds such as local domestic ducks, guinea fowls, cattle egrets and vultures in the spread and sustenance of HPAI in Nigeria; b) the role of live bird markets in the spread and maintenance of HPAI in Nigeria; c) molecular characterization of H5N1 virus and comparison with other isolates from poultry and humans from other countries; and d) continued active disease surveillance in various poultry production and marketing systems in Nigeria.

6. Conclusions

The ultimate objective of the background papers is to provide baseline information that can be used in the different activities of the project: from disease risk mapping to assessing the economic and livelihood impact of HPAI, to epidemiological and institutional analysis, and to determine the cost-benefit/cost-effectiveness that result from the implementation of several preventive and control measures. Although a lot of information related to the poultry sector and its role in the economy, livelihood, and nutrition have been collected, it was found that there is limited information currently available in terms of poultry statistics data (perhaps because of low economic incentive in collecting poultry related data before the AI outbreaks). Information resulting from discussions with experts and key stakeholders involved in HPAI research and the poultry sector in general were also considered and still a number of information and data gaps had been identified from the study countries. As much as possible the Project will address the gaps that are relevant within the study countries in the context of helping decision makers their preparedness and planning capabilities. Some of these identified gaps are summarized below.

One important gap identified 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 there is lack of clearness as to the relationship between farm size and biosecurity (FAO's classification). Thus, there is need for a more rigorous consideration of the links between scale of production and biosecurity (i.e., if biosecurity is considered as one of the criteria in classifying poultry production systems) in order to have a uniform structure of the poultry system, particularly the backyard poultry sector. In all the study countries, backyard poultry farms were defined as those farms operating under extensive technology, keeping birds at minimal inputs (typically with less than 50 birds); this definition loosely corresponds to Sector 4 in the FAO categorization. Large-scale farms, on the other hand, were defined as those using intensive technology, having at least 10,000 birds, and are vertically integrated with other actors along the supply chain such as hatcheries, feedmillers, and processors; this characterization corresponds to Sectors 1 and 2 in the FAO category, which is quite vague because the description is indistinguishable between the two sectors.

A well-defined classification of the poultry production system would aid in mapping the risk pathways, that is, understanding the flow and behavior of 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 transmission pathway 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 put emphasis on the relationship between livelihood and poultry in designing pro-poor HPAI reduction strategies. As indicated in the background papers, chicken and eggs are multiple inputs into the livelihood system; for example, chicken and eggs could be commercial goods that provide household income, or could serve as food which is a valuable source of protein, or could 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.

Another area where there is gap in the current state of knowledge is on cost-effectiveness of HPAI control measures. Much effort had been done to mitigate the risk of HPAI as well as strategic and emergency preparedness plans for the prevention and control of HPAI had been developed, but the cost-effectiveness of these efforts still remains to be seen particularly in a country with an endemic HPAI situation. For example, the Veterinary Services Directorate in Ghana, in coordination of the Avian Influenza Working Group used the following control measures: culling of poultry within the 3 km radius of the infected area, quarantine of infected farms, ban on movement of poultry and poultry products, disinfection of infected farms and equipment, and awareness campaigns on symptoms and risk of HPAI. These control measures were believed to be effective in containing the three HPAI outbreaks that occurred in the country. In fact, the 2005-2006 HPAI National Preparedness Plan and emergency actions undertaken contributed to the success of controlling HPAI in Ghana. The Participatory Disease Surveillance (PDS) established in several islands in Indonesia (includes Bali, Java, Kalimantan, Sulawesi, and Sumatra) was also claimed to be successful as an active surveillance program in detecting active cases of HPAI; however the coverage is limited to selected districts in the provinces (19 provinces) that are considered to be endemic.

In addition, there are questions related to incentives and compensation schemes that remain unanswered. Taking the case of culling of infected birds in point, stamping out was applied immediately to affected farms and those within a specified km-radius. The extent of culling being applied in each of the study countries infected with the disease (Ghana, Indonesia, and Nigeria) varied according to the HPAI situation in the country. Based on the information available, the authors of the background papers found that the provisions of compensation and sufficient logistics remain to be key issues in the success of this control strategy. They suggest that 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 the poor 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).

Concerning vaccination as an HPAI control measure, it 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 with clearly defined approach and exit mechanisms.

In the case of restructuring of the poultry sector, FAO recommends that the restructuring be based on-farm and market biosecurity measures. It is therefore crucial to conduct a careful review of the conditions and analysis of the impact of the restructuring of the poultry sector on the economic and livelihoods of poultry producers particularly the poor backyard poultry producers.

These are some of the control strategies being implemented in the study countries infected with HPAI virus. We know that these strategies work if used properly but as exemplified in the background papers, there are underlying constraints that limit their effective use. For prevention and control programmes to be successful and effective, both technical and financial support is needed from international and local development institutions in strengthening surveillance, detection and early reporting; strategic vaccination with good quality controlled vaccines, investment 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 market places; and in improving education and communication campaigns related to HPAI. Further, these measures entail a lot of economic costs so identifying the most cost-effective and socially equitable control measure for HPAI could be a large contribution in the efforts to prevent or reduce the risk of HPAI infection.

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APPENDIX A: Outline of the background paper for each of the study countries

1. **Introduction**
   - Motivation
   - Significance and scope of the paper
   - Summary of key findings
   - Road map
2. **Vital country statistics**
   - Land area and neighboring countries
   - National capital and its population
   - Official language(s)
   - Total Population, population density (by major cities and administrative region/district level) and rural population, growth rates of population and rural population (if available last 10 years)
   - Total GDP, GDP per capita, GDP and GDP per capita annual growth rate, agricultural GDP, agricultural GDP growth rate(if available last 10 years)
   - Human Development Index and urban and rural poverty rates(if available last 10 years)
   - Administrative regions and population density, proportion of rural population, per capita income and per capita agricultural income in each region/district (if available last 10 years)
3. **An overview of the economics and structure of the poultry sector**
   - Contribution of the poultry sub-sector to the livestock sector, agricultural GDP, and total GDP (if available last 10 years, and if possible please disaggregate by administrative regions/districts)
   - Number of people employed in the poultry sub-sector (if available last 10 years, and if possible please disaggregate by administrative regions/districts)
   - Share of poultry farmers (number and percent) to total agricultural household sector (last 10 years, if possible please disaggregate by administrative regions/districts)
   - Linkages between/contribution of the poultry sub-sector to other industries in the economy (such as the feed industry, catering industry, food processing industry); contribution of these industries to the overall economy and number of people employed by each (if available last 10 years, and if possible please disaggregate by administrative regions/districts)
   - Structure of the poultry sector
     - Definitions of the various poultry production systems in the country, such as the commercial (or industrial), semi-commercial and backyard production systems, and the linkages between these systems (such as workers of commercial or semi-commercial sector rearing poultry in the backyard system; producers of backyard system purchasing inputs from the commercial production system)
     - Numbers of commercial, semi-commercial and backyard production farms/enterprises and their distribution across the administrative regions/districts (if available last 10 years)
     - Number of different species of poultry in commercial, semi-commercial and backyard production systems (if available last 10 years)
     - Number of people employed in each one of the production systems and their distribution across the administrative regions/districts (if available last 10 years)
   - Poultry production, consumption and trade
     - Number of eggs and tons of poultry meat produced, consumed, imported and exported (trends over time and distributed across regions/districts) (if available last 10 years, and if possible please disaggregate by administrative regions/districts)
     - Income/price elasticities from previous/existing literature

- Trends in production and per capita consumption of total meat compared to chicken meat, eggs, and other poultry products, by administrative region/district (last 10 years)
- Trends of value and amounts of import and export of various poultry products (live birds, day-old chicks, frozen chicken and turkey, eggs, egg yolks) (if available last 10 years)
- List of countries where poultry products are exported to and imported from, and HPAI status in these countries (if available last 10 years)
- Tariffs on poultry meat/eggs
- Share of poultry in the import/export market (last 10 years)
- Proportion of commercial, semi-commercial and backyard population that enters the wet market system (distributed by administrative regions/districts) (if available last 10 years)
- Description of the major value chains for the poultry sector, and traceability systems for final produce (e.g., eggs and poultry meat)
- Volume and value of processed poultry meat
- Wholesale and retail prices of live birds, chicken meat, and eggs, by market, 1990-2007
- Trade flow of poultry and poultry products
- Marketing channels of poultry and poultry products
- Cost structure of producing

4. A detailed review of the poultry sector and biosecurity

For the information below please try to report the most recent year, i.e., the current situation (the latest data available) and when possible please disaggregate by administrative regions/districts

- Commercial/Industrial poultry production (fill in separate tables for chicken and turkey)

Breeding

	Present in country (yes/no)
Pedigree pure lines	
Great grand parents	
Grand parents	
Parents	
Layers	
Broilers	

Primary breeding companies: Around one dozen primary breeding companies supply the breeding stock from which almost all the commercial poultry meat (broiler or turkey) and table eggs are derived world-wide.

Grand-parent and parent stock are probably present in African and Asian countries

Commercial sector actors

Types	Breeds	Enterprises	Location of enterprises	Number of birds	Lifespan of birds
Parent stock					
Hatchery					
Rearing					
Broiler production					
Layer production					

Support service actors

	Number	Location	Integrated (linked to production)	Throughput (birds per year)
Feed mills				
Feed transport				
Transport day old chicks				
Firms transporting eggs				
Transport broilers and spent layers to abattoirs				
Egg packing plant				
Meat processing plant				
Abattoirs				
Poultry vaccine producers				
Specialized poultry vets				

- Backyard Poultry Production

Backyard poultry-keepers

Species	Present in country	Significant*	Numbers	Distribution - geographical	Breeds
Poultry					
Turkey					
Duck					
Geese					
Guinea fowl					
Quail					
Dove/pigeon					
Song birds					
Wild birds killed for meat					
Other					

* kept/exploited by more than 1 in 1000 people

- Poultry population density by district/region
- Informal sector poultry and egg trade

Informal sector egg sellers

Actors	Proportion	Numbers	Turnover (eggs/month)	Specialization
Producers				
Producer/retailers				
Wholesalers				
Wholesaler/retailers				
Retailers				

Informal sector chicken sellers

Actors	Proportion	Numbers	Turnover (eggs/month)	Specialization
Producers				
Producer/retailers				
Wholesalers				
Wholesaler/retailers				
Retailers				

Actor summary

Score each actor:
7: More than 1 million
6: 100,000 to 1,000,000
5: 10,000 to 99,999
4 1,000 to 9,990
3 100 to 999
2 10 to 99
1 1 to 9
0 None present in country
NA no information available

Breeders Pedigree pure lines Great grand parents Grand parents Parents Layers Broilers	Backyard poultry Poultry Turkey Duck Geese Guinea fowl Quail Dove/pigeon Song birds Wild birds killed for meat Other	Support services Feed mills Feed transport Transport day old chicks Firms transporting eggs Transport broilers and spent layers to abattoirs Egg packing plant Meat processing plant Abattoirs Poultry vaccine producers Specialized poultry vets
Commercial sector Parent stock Hatchery Rearing Broiler production Layer production	Informal sector poultry sellers Producers Producer/retailers Wholesalers Wholesaler/retailers Retailers	Informal sector egg sellers Producers Producer/retailers Wholesalers Wholesaler/retailers Retailers

- For each player present in the country please describe the following
    - Typical species kept (e.g poultry, cattle, goats)
    - Typical types of birds kept (e.g. chicken, duck, quail)
    - Typical number of birds kept (e.g. 10 per hh) and range (e.g. 2 to 50)
    - Housing
        - Day: Housed, free-range, semi free-range, scavenging
        - Cages, perches, litter,
        - Night: housed with family, poultry shed, animal house, none
        - Floor (e.g concrete), walls (e.g cement), roof (e.g. thatch)
        - Fenced enclosure or open
- Bio-security
    - Describe biosecurity systems in place and costs associated with implementing developing different systems (disaggregated as much as possible)
    - Contact with wild birds possible
    - Contact with other domestic birds possible
    - Free entry of materials/birds to premises
    - Free exit of materials/birds from premises
- Routine animal health practices
    - What vaccines at what age
    - Antibiotics – what, when, from where
    - Coccidiostats- what, when, from where
    - Growth promoters - what, when, from where
    - Mineral and vitamin - what, when, from where
    - Calcium - what, when, from where
    - Deworming - what, when, from where
    - De-beaking, pinioning
    - Other
- Use of poultry health service provider and associated costs (if known)
    - In house veterinary services – how often, does what
    - Private veterinarian visiting farm- how often, does what
    - Private veterinarian supplying drugs how often, does what

    - Public veterinarian visiting farm how often, does what
    - Public veterinarian supplying drugs how often, does what
    - Technician how often, does what
    - Community animal health worker how often, does what
    - Other farmer how often, does what
    - Poultry owner or family how often, does what
    - Other
- Where poultry are obtained
    - % Bred on farm
    - % Bought in
    - Age bought in, geographic place (s) bought from, distance from farm
    - Type of supplier (e.g. wet market, breeder, neighbor farmer, trader)
- Feeding
    - Feed given
    - Type of feed given
    - Where feed obtained from (place, distance)
    - Type of supplier (e.g feed mill, agrovet shop, other farmer)
- Marketing and other use of poultry and poultry products
    - % sold, % eaten, % gifts, % other (sacrifice, etc.)
    - Where sold (place and distance)
    - Type of buyer (e.g. vendor, hotel, consumer)
    - Seasonal trends in marketing (e.g. peaks at festivals
- Vertical and horizontal integration with other actors
    - What proportion of each actor operates within a completely integrated system (i.e all poultry activities and input suppliers, output buyers, owned by a single firm), a partially integrated system, and a non-integrated system

Complete the following matrix for all actors identified as important:

a) Exchange of poultry/inputs, outputs from column to row (P1 high, P2 medium P3low)
b) Exchange of information from column to row (I1=high, I2= medium, I3= low)_
c) Level of trust (T1=high, T2=medium, T=3low)
d) frequency of interaction: daily, weekly, monthly, less than monthly, never

		Commercial			Backyard			Support			Informal egg sellers		
		Rearing	Broiler		Chicken	Duck		Feed mill			Prod	Ret	Whol
Commercial	Rearing	P2 I3 T2 Wkly			XXX								
	Broiler												
Backyard	Chick	YYY											
	Duck												
Support services	Feed mill												
	Transport day old												

Note the matrix reads FROM column TO row, so box XXX contains the level of exchange of material, information and trust FROM the backyard TO the commercial, and box YYY contains the level of exchange of material, information and trust FROM the commercial TO the backyard

- Stability (continuity) of each actor over time and space
  - For each actor of importance note the following:
    - For how many years present in country
    - Are numbers increasing, decreasing, staying the same
    - Present in urban, peri-urban, rural,
    - Geographical reach increasing, decreasing, staying the same

		Present	Numerical trend	Location	Geographic trend
Commercial	Rearing	30 years	Up	Urban	Up
	Broiler	20 years	Up	Urban	No change
Backyard	Chick	Always	Up	All	
	Duck	Always	No change	All	
Support services	Feed mill	50 years	Up	Peri-urban	
	Transport day old	30 years	Up		

- Production systems and biosecurity: Please discuss briefly and estimate importance of following biosecurity risk factors: For each risk factor indicate: a) is it a problem or not; b) how many premises are affected c) in what proportion of cases does it take place?

- Vaccination teams who cover more than one farm and who do not disinfect thoroughly between premises
    - A problem in this country
    - 100 teams: Commercial firms use in house vaccination teams but backyard flocks are vaccinated by government vet services.
    - 80% do not disinfect thoroughly
- Vehicles, containers and catching teams used to transport birds to production units not cleaned and sanitized before and after visits
- Hatching egg (HE) collection vehicles, equipment, packaging material and staff not cleaned and sanitized before and after visits
- Reject egg collection vehicles, equipment, packaging material and staff going from farm to farm
- The disposal of surplus males just prior to the commencement of lay to workers, markets or backyard industry
- The acquisition of replacement males due to a shortage of males during the laying period
- Drivers not following biosecurity procedures
- Imports of HE and DOC arriving in contaminated vehicles and containers
- Disposal of non-hatching eggs, unhatched eggs, culled chicks and contaminated packaging materials
- Disposal of manure to the environment
- Inadequate cleansing and disinfection of catching vehicles, equipment, bird containers
- Poor staff hygiene and lack of clean protective clothing needs
- Depopulation lasting more than 48 hours.
- Birds going to more than 2 abattoirs
- Lack of integration (e.g DOC, HE suppliers, feed mills, abattoirs belonging to different actors)
- Different age groups of birds on any one farm not separate

1. Poultry and rural livelihoods

For the information below, unless otherwise stated, please try to report the most recent year, i.e., the current situation (the latest data available) and when possible please disaggregate by administrative regions/districts.

- Backyard poultry production, allocation of labour and gender issues:
    - Main decision maker in backyard poultry production, their gender, education levels and agricultural experience
    - Roles of men, women, and children in rearing poultry, marketing of eggs, live poultry and poultry meat, and other poultry products (e.g., feathers)
    - The extent of the involvement of vulnerable family members such as children, elderly and the invalids, in backyard poultry production and marketing of poultry products
- Importance of poultry in household income: Proportion of household income that come from sales of poultry or poultry products (could be in a table showing the proportion of household income that come from other income sources, e.g., other livestock sales, crop sales, off farm employment income etc.) (if available last 10 years)
- Importance of poultry in nutrition (micronutrients) and food security:
    - Information from any dietary intake surveys that have been relatively recently conducted in the country: usual intakes of protein, vitamin A, zinc, iron, and other nutrients where available
    - Please list food composition database used in your country

- Information about household food expenditures: what foods are purchased and where
- Information about any recent nutrition surveys (not including DHS surveys) in your country collecting data on infant and young child feeding practices; biomarkers/clinical or functional markers of micronutrient nutrition (anemia, vitamin A, night blindness, etc), and anthropometry (weight, height/length, skinfolds, mid-upper arm circumference MUAC, birthweight)
- Number of times a week/month an average household consumes poultry meat
- Number of times a week/month eggs preschool (younger than 5 years) and school age children (5 to 12 years) consume poultry meat and eggs
- How is poultry meat prepared for consumption: cooking methods
- How eggs are usually consumed: raw, fried, boiled

o Importance of poultry in local culture and/or religion
- Festivals, celebrations and functions in which poultry play an important role
- Special local dishes in which poultry products are main ingredients
- Importance of poultry as a gift in special occasions etc.

6) Previous HPAI research and findings in the study country

o Research carried out by national institutions (methods and approaches used, main findings and conclusions)
o Research carried out by international institutions (methods and approaches used, main findings and conclusions)
o Research gaps

(Please provide information on: Authors, Paper Title, Publication, and please attach an electronic or hard copy)

7) Threats and incidences of HPAI and institutional response capacity

For the information below, unless otherwise stated, please try to report the most recent

year, i.e., the current situation (the latest data available) and when possible please disaggregate by administrative regions/districts.

o History of other previous major diseases in poultry and control measures (those diseases that are comparable in terms of similar epidemiology, as well as other livestock diseases when applicable) (if available last 20 years)
o For the following indicator diseases indicate if present, prevalence (estimate %), if an official disease control program exists, if private sector disease control exists, success of control

	Presence	Prev.	Public cntrl	Private cntrl	Effective
Low pathogenic AI					
Newcastle disease					
Gumboro disease					
Poultry campylobacter					
FMD					
CBPP					

Threats/incidence of HPAI in the country (if any)

- Incidence of disease over time and across regions

	Outbreak 1	Outbreak 2		
Date of outbreak				
System affected				
Areas affected				
Diagnostic test used				
Diagnostic test result				
Numbers affected				
Numbers died				
Numbers culled				
Numbers vaccinated				
Vaccine used				
Other control measures				
Effectiveness of control				

- Evidence for unreported or undetected HPAI
    i. What % of outbreaks are detected according to different expert opinion (state vet, poultry firms, development workers)?

- Economic impacts of HPAI (due to either actual outbreaks or false alarms)
    - Number of poultry culled, total value of culled poultry, cost of diagnostics tests, costs of culling, disposal costs, cleaning and disinfection costs, decontamination costs, and other measures taken to contain/eradicate the disease, costs of compensation, cost of administering these control measures, by production system (commercial, semi-commercial and backyard) and by administrative region/district
    - Changes in the numbers of commercial, semi-commercial and backyard production farms/enterprises by administrative region/district before and after the outbreak (or over the period 2000-2007)
    - Costs of vaccines if used
    - Number of businesses that went bankrupt and number of people lost employment by production system, by administrative region/district
    - Reductions in domestic consumption of poultry products (meat, eggs, frozen, processed foodstuff with poultry) if possible please disaggregate by administrative region/district
    - Impacts on other industries in the whole poultry value chain, such as the economic impacts (e.g., losses in revenues, employment etc) on the producers of processed food which use poultry; producers of poultry feed; producers of day-old-chicks, veterinary medicines and other relevant inputs to poultry production, if possible please disaggregate by administrative regions/districts
    - Losses in poultry (meat, eggs, frozen, processed foodstuff with poultry) export revenues

- Drop in demand in food services, tourism, retail trade, and other spillover effects

- What are the main ministries and other public institutions responsible for the poultry sector and HPAI management, definitions of these institutions' roles
- Current policies, laws and legal and regulatory systems related to the poultry sector and HPAI as well as disposal of dead or culled birds such as those on
  - Agriculture and livestock sector in particular
  - Food safety, food production, food standardization
  - International trade
  - Environment
  - Transportation
- Country-level organizational structure for HPAI management
  - List of actors that influence HPAI management (prevention and control) (e.g., Government agencies (e.g., ministries and related department), other public institutions, private institutions (such as large scale commercial poultry produces, input suppliers), non governmental organizations (e.g., farmers' associations, consumers associations), international donors (WB, WHO) and research organizations, media). The roles of each one of these institutions (command, provide information, provide input, provide funds etc) and their interlinkages with each other. Ranking of these institutions according to their level of influence on HPAI management
  - Major institutional service deliveries (veterinary systems, research and extension, role of the private sector)
    - Number of veterinarians per administrative region/district
    - Number of HPAI detection laboratories in the country
  - Institutional overlaps and synergies (roles and responsibilities)
  - Decentralization and responsibilities (national versus sub-national, i.e. local/districts/villages)
  - State of infrastructure and technologies for risk communication (e.g. for reporting diseases)
- Information Awareness and Reporting (For those countries that have not yet experienced HPAI on a grand scale, please describe as much as possible; in particular, focus on preventive mechanisms) Note: In all cases, include as much detail as possible, citing all sources, references, websites
  - What is the current state of information on HPAI? How much do people know, in particular, smallholders, farmers, urban and rural populations about the disease, its symptoms (i.e., how to identify it), its risks?
  - What is the current state of information on HPAI? How much do people know, in particular, smallholders, farmers, urban and rural populations about the disease, its symptoms (i.e., how to identify it), its risks?
  - Are there informational campaigns informing the public (in particular, smallholders, farmers) about the threats of HPAI? If so, explain: (1) what do they consist of, (2) how is information communicated (media, bulk mail/pamphlets, Internet, farmer and community groups etc.), (3) please include all references, websites with further information etc. Please be as detailed as possible and include any kind of social marketing or informational campaigns, regardless of how small or large. Also include information on past diseases that may have required similar informational campaigns and how such campaigns were organized.
  - Are there informational campaigns informing the public about the symptoms of HPAI, i.e., how to identify an occurrence among the poultry population? Address the same questions as above.

- Is the public (in particular, smallholders, farmers, rural population) aware of how and where to report occurrence of HPAI? I.e., do they know what government agencies/institutions need to be contacted and how these should be contacted, e.g., by phone, mail, e-mail/Internet, direct communication by physically reporting?
- What is the current state of infrastructure and technologies (e.g., roads, landlines, cellular technology, Internet/email) in urban and rural areas? It is important to have an accurate and detailed picture of farms, the rural poor, smallholders and areas/neighborhoods that have or are most likely to be affected by an occurrence of HPAI. Namely, this information can be used to assess the transaction costs of reporting HPAI for the target population of interest, namely, smallholders, farmers, the rural poor.
- What is the current state of action and reporting mechanisms? I.e., is there an official government precedence for action when HPAI is reported? Also, is there a clear precedence established for reporting HPAI when it occurs? If so, is this communicated through campaigns above? Normative questions: If HPAI is detected, what should happen? How and to whom to report? If HPAI is reported, what should happen? How should the government act? Positive questions: If HPAI is detected, what actually happens? Is it reported? How does the government actually act?
- Does the government reporting mechanism involve compensation? Normative questions: If a farmer reports HPAI occurrence, should they be compensated? Does the government promise to compensate for reporting (i.e., what do the laws, regulations say)? How much should they be compensated? Positive questions: Does the government actually compensate for reporting (i.e., what actually happens)? How much are they actually compensated?
- If the government does not compensate for reporting, what is the reasoning? Is it insufficient funds? Is there any particular reason why compensation is not done?
- If the government does compensate, what does such compensation consist of? Is it monetary compensation or non-monetary? What does compensation consist of? What are the requirements for compensation, i.e., what are the conditions under which one gets compensated? How is compensation done, i.e., in cash, kind, via checks, vouchers? How fast is compensation done, i.e., how long after reporting does the reward get transferred? What are the transaction costs for getting the reward? E.g., is the compensation sent via the mail, through a local government office or does the farmer, smallholder or rural inhabitant have to travel considerably to reap the benefits?

8) Risk factors/risk assessment

- Has any risk assessment for HPAI been undertaken?
  - Quantitative or qualitative? What was the conclusion?
  - Obtain a copy or summary of findings
- Potential different pathways of introduction
  - Wild migratory birds
    - List/provide maps of flyway routes of migratory birds (by species) and likely resting areas. Indicate which rest in water bodies
    - Period of migration of migratory water wild bird (months)
    - Approximate numbers birds migrating
    - Describe the route of migratory water wild birds- origin, countries pass through, destination
    - Describe of contact among migratory water wild bird and local water wild bird, contact among migratory water wild bird and domestic poultry: Where

does it occur? When does it occur? What poultry systems are involved? What numbers are involved?
- Prevalence of H5N1 on migratory water wild birds in this country

- Wild non-migratory birds
  - Evidence (or not) of virus activity in each specific wild bird species
  - Name and list of local water wild birds susceptible to be infected by H5N1 and geographical localization
  - Prevalence of H5N1 on local water wild birds
  - Indicate contact among local water wild bird and domestic poultry
- Legal imports
  - List/Maps of ports of entry for legal import of poultry and poultry products – include land, sea, air
  - Type of poultry and poultry products legal imports (type, quantity, country of origin, how long trade has been carried out)
  - List of bordering countries
  - Current and historical AI situation in bordering countries (including geographic occurrence of outbreaks within the country, if applicable)
  - Border controls in place and discussion of their effectiveness
- Illegal and informal import
  - List/Maps of potential illegal points of entry for poultry and poultry products
  - List of most likely types of illegal imports of poultry/poultry products and estimate scale in number/weight
  - Motivations for illegal entry
    - Smuggling (price differential across borders)
    - Inputs to commercial systems (HE, DC)
    - Gifts, food (and seasonal patterns –e.g. migrant workers returning at Christmas, Eid)
    - Movement of people
    - Accidental (lorries, discarded food waste etc)
  - List of countries of origin of legal poultry and poultry products imports

- Pathways for spread
  - Distribution of poultry production by system in the country
  - List of destinations for legal poultry and poultry products imports (by type)
  - List of the most likely destination for illegal poultry and poultry products imports (by type)
  - List/maps of animal/poultry markets in the country
  - List/maps of domestic poultry and poultry products routes inside the country
  - List of common means of transportation of poultry and poultry products in the country by poultry system and proportion moving by each route (foot, car, minivan etc)
  - Controls on movement of poultry within countries
  - Current situation of AI in the country of study
  - For any of these items, whenever possible and applicable get quantitative estimates (volumes, number of birds, size of shipments etc.) for use in the risk assessment etc.

9) Conclusions

- Summary of main findings
- Preliminary/initial policy recommendations
- Current knowledge gaps where the research project should focus