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HPAI HIGHLY PATHOGENIC AVIAN INFLUENZA PRO-POOR HPAI RISK REDUCTION

Alignment of poultry sector actors with avian influenza control in Kenya

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Preface

Since its re-emergence, highly pathogenic avian influenza (**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.

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More information

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

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Acronyms

ANOVA	Analysis of variance
DFID	Department for International Development (UK)
DVO	District Veterinary Officer
DVS	Director of Veterinary Services
FAO	Food and Agriculture Organization of the United Nations
GPS	Global Positioning System
HPAI	Highly pathogenic avian influenza
IFPRI	International Food Policy Research Institute
ILRI	International Livestock Research Institute
LGP	Length of growing period
MoLD	Ministry of Livestock Development

Glossary

Farm Categories (FAO 1994)

Sector 1 farm: Industrial integrated system with high level of biosecurity and birds/products marketed commercially (e.g. farms that are part of an integrated broiler production enterprise with clearly defined and implemented standard operating procedures for biosecurity)

Sector 2 farm: Commercial poultry production system with moderate to high biosecurity and birds/products usually marketed commercially (e.g. farms with birds kept indoors continuously; strictly preventing contact with other poultry or wildlife)

Sector 3 farm: Commercial poultry production system with low to minimal biosecurity and birds/products entering live bird markets (e.g. a caged layer farm with birds in open sheds; a farm with poultry spending time outside the shed; a farm producing chickens and waterfowl)

Sector 4 farm: Village or backyard production with minimal biosecurity and birds/products consumed locally

Executive Summary

Kenya has a high risk of being infected with highly pathogenic avian influenza (**HPAI**) because it (i) lies along the migratory bird routes, (ii) engages in formal and informal cross-border trade in live birds and other poultry products, (iii) lacks capacity to regulate the poultry industry trade and (iv) is well connected to the region and with the rest of the world through its air and road transport networks. The government developed a contingency plan for prevention and control of the disease in 2005 which describes a set of mitigation measures that could be implemented at various stages of the outbreak. The contingency plan identifies national and international agencies as well poultry value chain actors as being key players that would either deliver or implement HPAI control measures. It has not been established, however, whether these players would comply appropriately to ensure the successful implementation of the HPAI control measures. This is because actor willingness to comply depends fundamentally on the alignment of control measures with actor capacity to comply, their current practices, and incentives they face. This study (i) characterised control measures in terms of expected degree of compliance by actors in the poultry value chain and the agents responsible for implementing the measures, and (ii) identified actors who may be expected to prove to be compliance fail-points to successful implementation of control measures. Four HPAI control measures were studied: these are biosecurity, reporting, movement control, and culling and compensation.

The study used a supply chain (backyard, small-scale broiler and layer live-bird supply chains) as the unit of analysis. It focused on live birds because they represent the greatest risk of H5N1 HPAI virus transmission through virus shedding and contamination of inanimate materials. Questionnaires were designed based on specific practices, incentives and capacities associated with each mitigation measure. A standard Likert scale, which allows for the measurement of the direction and intensity of attitudes, opinions or convictions, was considered appropriate for evaluating the degree to which the socio-economic characteristics of the supply chain actors were aligned with the requirements for successful implementation of the selected HPAI mitigation measures. Scores ranging between 1 and 5 were then assigned to answers to sets of questions. Average scores for groups of actors were generated and used as alignment indexes to answer two key questions: (i) what mitigation measures are likely to enjoy better compliance and therefore achieve the expected technical effectiveness, and (ii) for each control measure, where do potential compliance fail-points lie and how might they be addressed?

A total of 12 backyard chicken producers, 13 small-scale layer producers, 8 small-scale chicken producers, 22 transporters, 30 traders, 28 retailers and 29 mitigation agents were interviewed. On the analysis of the Likert scale data, the main observations made include:

- Reporting is expected to achieve a higher degree of compliance from chicken supply chain actors (sectors 3 and 4)[1] and mitigation agents, and measures aimed at improving reporting practices, especially among backyard chicken producers, are expected to have positive impact. Conversely, culling and compensation will not achieve sufficient levels of compliance unless measures to address current behaviour and capacities are addressed.
- Transporters emerge as the potential fail-points for compliance with improving biosecurity measures. Transporters, and to a great extent retailers, do not have adequate capacity to

[1] See the Glossary for definitions of the sectors.

implement such measures. Some of the actions that can be taken to improve their capacities include improving access to informational, financial and human resources through training and improving access to micro-credit services.

- Poor compliance with movement control can be attributed to poor alignment with the existing practices, mainly among traders, as well as weak capacities of the mitigation agents. Attention needs to be focused on improving the capacity of the departments that implement movement controls and also adjusting movement control policies to allow for transport of chickens under certain conditions to minimize losses.
- Existing practices for most actors in the chicken supply chain, and in particular for traders, are not aligned with the requirements for the implementation of culling and compensation. The culling and compensation policy will need to be developed through a participatory process to enhance ownership given that it may not be possible to provide adequate compensation all the time. More research is also needed in this area to determine the most effective way of implementing the measure.

1. Justification and objectives for the study

Kenya has not been exposed to highly pathogenic avian influenza (**HPAI**) but it is regarded as having a high risk of being infected because it lies under the route of migratory birds and engages in formal and informal cross-border trade in poultry and poultry products. When HPAI first occurred in Africa in 2006-2007 (specifically in Egypt, Djibouti, and West Africa: Nigeria, Niger, Burkina Faso, Côte d'Ivoire, Ghana, Togo and Benin), Kenya experienced a scare that resulted in a loss of an estimated Kenya Shilling 2.3 billion due to reduced demand for poultry products (Kimani et al. 2006). Estimates of the expected impacts of an outbreak under varying scenarios have been given by Thurlow (2010). He indicates that a severe and lengthier outbreak will occasion economy-wide losses that would reduce economic growth by 0.12 percentage points per year and increase the number of Kenyans living below the poverty line by almost half a million. The contingency plans developed by the government for early detection, prevention and control of HPAI outline a number of mitigation measures that could be used to prevent or control the disease. These measures include enhancing surveillance and epidemiology, culling and compensation, enhancing biosecurity, implementing targeted vaccination programs, quarantine and movement control and developing appropriate regulations and mechanisms for their implementation.

Kenya could benefit greatly from experiences, knowledge and lessons that have been gained by countries that have had HPAI such as Nigeria, Ghana, Egypt and Indonesia. However, the diverse socio-economic and political contexts and the uncertainty about how the disease would behave locally limit the extent to which those lessons could be applied. For example, Kenya, compared to Egypt and Indonesia (where the disease is endemic) has a (i) centrally-coordinated veterinary infrastructure with variable interaction with local communities, (ii) small proportions of commercial or semi-commercial poultry (~14%) and waterfowl and other poultry (~2%) that are often regarded as being important in maintaining the disease, and (iii) lower human population density.

Poultry producers and other actors of the poultry value chain as well as mitigation agents are expected to play central roles in the implementation of the measures identified in Kenya's National Action Plan. It is however not clear whether relevant characteristics of these actors in terms of their capacities, incentives and practices align appropriately with the requirements for implementing the prescribed control measures. If these characteristics align well, then these measures can be expected to be used more widely and effectively with beneficial outcomes; however, if such characteristics of some key actors are not aligned with the control measure, then these measures are likely to perform poorly. This study focuses on assessing the likelihood of successful compliance of control measures, ignoring any scientific uncertainty about the technical effectiveness or appropriateness of the candidate mitigation measures.

The specific objectives of the study are:

- Characterize control measures in terms of expected degree of compliance by actors in the value chain and the agents responsible for their implementation
- Identify which actors may be expected to act as compliance fail-points to successful implementation of control measures.

2. Study design

2.1. Conceptual framework

The behaviour of actors involved in HPAI control is influenced by the interaction between the nature of their poultry-related activities, the nature of the disease and risk of its transmission, and the nature of mitigation measures and how they are implemented.

The value chain dimension

The poultry sector is defined by a set of diverse actors serving a range of functions along production-to-consumption poultry supply chains, and by the relationships and transactions between these actors. This is part of the context in which HPAI outbreaks occur, and in part determines how these outbreaks may happen and then evolve.

The value chain concept as described by Kaplinsky and Morris (2001) provides a useful framework for describing the poultry sector, its structure and its dynamics. Key to the concept is the emphasis on how capacity among actors and the incentives they face, whether financial or through governance mechanisms within the chain, affect the performance of the value chain.

The risk pathway dimension

HPAI outbreaks and the effectiveness of measures taken to control them are determined by the interplay between the nature of the disease itself and the value chain context into which it is introduced. Risk analysis approaches have proven powerful in applying epidemiology to evaluate the risk of disease associated with a commodity along its production-to-consumption path. The description and analysis of such risk pathways generally focus on the relationship between practices in handling the commodity that influence exposure to and spread of the disease, and inform potential mitigation strategies. Risk analysis techniques do not, however, typically assess the ability or willingness of actors in the risk pathway to adopt or comply with such strategies.

The disease control dimension

Various measures are taken to reduce the risk of HPAI outbreaks and to control it when an outbreak does occur. Some measures may be taken directly by the actors within their domain in the poultry value chain to protect or promote their individual interests, but most are generally considered the responsibility of actors external to the value chain, particularly public veterinary services that implement measures in the value chain in the interest of the public good. Prevention strategies include ‘peace time’ measures such as ensuring surveillance, laboratory support, contingency planning, enabling legislation, communication to raise awareness, training, movement controls, vaccination, biosecurity and restructuring. When faced with an outbreak, measures include movement restrictions, culling, compensation, disinfection and use of personal protective equipment. Each strategy has its technical specificities and may apply to or affect the various actors within the value chain in different ways. Which measures are promoted and implemented depend in principle on the best available evidence as to their relative cost and effectiveness given current knowledge of HPAI epidemiology. In reality, lack of definitive evidence or consensus on the best practices for choosing and implementing control measures leads to decision making influenced by a variety of stakeholders (e.g., veterinary professionals, poultry industry, international agencies,

donors) from both within and outside the value chain, and each having their specific interests and perspective.

The choice of control measures to adopt is based on which is perceived to have the optimal epidemiological impact on suppressing the disease, while at the same time being politically feasible. When applied, control measures often do not achieve the full intended effect, which can be attributed to insufficient capacity or willingness to implement the measure as intended, insufficient capacity or willingness to comply with the measure as intended, or a combination of the two.

Integrating the three dimensions

Drawing on each of the three dimensions – value chain, risk pathway and disease control – allows us to begin understanding the institutional aspects of HPAI and its control. The central players are the value chain actors (individuals, firms, or organizations), each defined by its capacities and its incentives. These capacities and incentives determine the types of practices adopted when handling poultry or related commodities (both internally and when transferring products between the actors), which in turn influence the risk of HPAI being introduced or spread along this risk pathway. The relationship between any pair of actors and the arrangements governing their transactions are also factors.

Disease control strategies are imposed on the value chain actors to reduce disease and its risk along the risk pathway. The choice of strategy is a function of the capacity of the mitigation agency, as well as the institutional and individual incentives of management and staff of that agency, which are conditioned in turn by other stakeholders and their respective incentives. How effective the selected strategy is in reducing disease and its risk then depends not only on its technical efficacy, but also again on the capacity and incentives of the mitigation agency to deliver it as intended, and of the capacity and incentives of the value chain actors to comply with it as intended.

Based on this framework, the present study developed an approach for evaluating the capacities, practices and incentives associated with each category of value chain actor, including those responsible for implementing HPAI control, as relevant to each of the principal control measures that could be used in Kenya in the event of an outbreak, to ask the question: to what degree is the control measure intrinsically aligned, or not, with these critical characteristics for each type of actor? This degree or index of alignment can then be used to qualify whether the control measure may be expected to perform to its technical expectations or be less effective than expected due to poor compliance, as well as to identify where accompanying measures may be appropriate.

2.2. Development of the research design

This section gives a summary of the methods used in the study.

Live-bird supply chains

The study used a supply chain as the unit of analysis rather than individual actors because it is difficult to design a sampling strategy that provides representative numbers and distribution (in space) of the various heterogeneous and often ill-defined categories of poultry value chain actors. The study focused on backyard and small-scale broiler and layer live-bird supply chains because live birds represent the greatest risk of HPAI (H5N1) virus transmission through virus shedding and contamination of inanimate materials. According to a widely used categorization of poultry

production systems established by the Food and Agriculture Organization of the United Nations (**FAO**), small-scale broiler and layer systems correspond to sector 3 and backyard chicken systems to sector 4 (see the Glossary for the complete categorization). Layer chickens refer to spent hens sold for breeding or meat consumption (Kimani et al. 2006).

Dressed chickens were not considered a significant risk for disease transmission; therefore, the last actors considered in the supply chain were the retailers who traded in live chickens before being dressed. Eggs supply chains were not included because it is unlikely that eggs would contribute to the recycling of the virus back to the farms either as fomites or through the contamination of transport materials such as trays.

Questionnaires and Likert scale

A standard Likert scale, which allows for the measurement of the direction and intensity of attitudes or opinions was considered appropriate for evaluating the degree to which the socio-economic characteristics of the value chain actors (capacities, incentives and practices) were aligned with the requirements for successful implementation of HPAI mitigation measures. Questionnaires were designed based on a matrix that identified specific practices, incentives and capacities associated with each mitigation measure being assessed, i.e. biosecurity, reporting, movement control and culling and compensation (Table 1). The Likert scales were based on a sufficient number of questions to permit parametric statistical comparison of average scores across sets of actors (Clason and Dormody 1994). This method allows for qualitative interpretation of alignments across actors and where inadequate implementation or compliance might be expected.

A Likert scale consists of at least five Likert-type items with each item composed of a stem, which is a statement of an attitude, and an ordered set of options representing a full range of the attitude being measured; examples of Likert questions generated from the items listed in Table 1 are given in Box 1. A respondent chooses one of these options as a response to the statement being posed. Although Likert-scale data can be analysed by nonparametric procedures (Agresti 2002; Fleiss 1981), applying parametric procedures to Likert-scale data analysis is still conveniently adopted by researchers in social sciences.

The content and range of questions in the questionnaires were adapted for each set of actors and mitigation agents specific to the type of business they were engaged in and the types of mitigation measures relevant to them. For each of the mitigation measure x socio-economic factor combinations, at least five statements were constructed and each statement assigned one of the following scales depending on the issue that was being assessed:

- Always, Often, About half the time, Seldom, Never
- Strongly disagree, Disagree, Neither agree nor disagree, Agree, Strongly agree
- Very likely, Likely, Neither likely nor unlikely, Unlikely, Very unlikely

Questionnaires for producers, traders, retailers and mitigation agents covered all four mitigation measures. Questionnaires for transporters, however, did not include a section on culling and compensation since this measure is not applied to them. All questionnaires for the supply chain actors (producers, transporters, traders and retailers) included a section where perceptions on whether mitigation agents had the required capacities and incentives to implement movement control measures were recorded. Similarly, questionnaires for mitigation agents had a section for

Table 1. An outline of the capacities, incentives and practices that the value chain actors that served as the basis for formulating questions for each mitigation measure

Control measure	Practices	Incentives	Capacities
Biosecurity	- Frequency at which chickens mix with other animals - Length of time chickens are kept enclosed in a defined place - Whether newly introduced birds are directly mixed with old birds - Whether dead birds are disposed properly	- Desire to improve business opportunities and efficiency - Desire to improve performance and survival rates - Costs in terms of time and finance required to adopt the best practice - Compliance with regulations to gain social approval, etc. - Avoiding wastage, improving value of by-products, e.g. manure - Social capital	- Access to information about best practices - Financial resources, whether own or through credit services - Availability of labour and time to implement biosecurity measures
Reporting	- Whether or not actors report disease outbreaks to veterinary or market authorities - Whether or not actors share information on disease outbreaks with others, who in turn might report	- Improving ability to protect their flock from disease, or getting help to control a problem - Fear of culling or not accessing markets - Protecting neighbours' flocks from getting infected, being culled, not accessing markets	- Access to authorities, both in terms of being aware that they should report, and then getting information to them when disease outbreaks occur - Access to information about disease problems that might affect them - Having transport, time or finances to travel to report
Culling and compensation	- Measures taken to avoid culling e.g. moving, selling, hiding or eating chickens beforehand - Accepting to participate in culling	- Reduction of disease risk to their family, their flocks or those of neighbours - Fear of being punished by the authorities	- Reliance on chickens for income, food and other livelihoods - Ability to wait for compensation - Ability to wait for an appropriate time for re-stocking
Movement control	- Keeping poultry confined and limiting access - Whether producers would disobey movement controls	- Protecting own and neighbours' poultry from catching the disease - Traders buying chickens at low prices in quarantined areas - Fear of being punished from violating quarantine measures	- Having housing, feed and water to keep chickens until quarantine is lifted - Having alternative sources of income during quarantine period - Having facilities to store dressed birds
Perceptions on implementing agents		- Perceptions on factors that may motivate mitigation agents to implement disease control measures well e.g. allowances, bribes, professional satisfaction - Level of trust of the community on mitigation agents	- Perceptions on the level of resources e.g. staff, transport, financial that the mitigation agents have for disease control operations

Box 1. Examples of Likert items regarding HPAI control through culling asked to small-scale commercial chicken farmers

To assess alignment of culling with farmer **practices**:

Q. Some producers may try to hide their healthy chickens to avoid having them killed

☐ Strongly agree 1 ☐ Agree 2 ☐ Neither agree or disagree 3 ☐ Disagree 4 ☐ Strongly disagree 5 ☐ Don't know 0

To assess alignment of culling with **incentives** faced by the farmers:

Q. Cooperating with culling will reduce the risk to your family and workers

☐ Strongly agree 5 ☐ Agree 4 ☐ Neither agree or disagree 3 ☐ Disagree 2 ☐ Strongly disagree 1 ☐ Don't know 0

To assess alignment of culling with farmer **capacities**:

Q. I can cooperate with culling because my poultry business is just a portion of my income

☐ Strongly agree 5 ☐ Agree 4 ☐ Neither agree or disagree 3 ☐ Disagree 2 ☐ Strongly disagree 1 ☐ Don't know 0

their perceptions on whether the practices, capacities and incentives of broiler and layer producers (FAO sector 3) were aligned with the requirements for movement control. These sections allowed triangulation of self-reported versus third-party perceptions. At the end of the section for each mitigation measure, two open-ended questions were inserted. These questions asked each actor or mitigation agent to state reasons to explain why they could or could not implement the measure. This information would be used to explain some of the attitudes measured using the Likert scale. The enumerator guide and questionnaire for small-scale commercial chicken farmers is reproduced in Annex 2 as a more complete example.

Spatial random sampling

The study was conducted in higher potential areas to ensure that the findings represented a significant proportion of the poultry population. The length of the growing period (**LGP**) was used as a proxy for agricultural potential with an assumption that regions with longer growing periods had higher human and poultry population density than those with shorter growing periods (e.g. pastoral areas). The study was therefore implemented in regions having an LGP of $\geq$105 days (Figure 1).

It was necessary to use an expansive area for this study to minimize spatial autocorrelation in responses as well as premature convergence of the supply chains. Data collected in a small area are more likely to be positively correlated (observations are more comparable than those taken from a variety of areas). However, data were still correlated at the respondent level because each respondent was expected to give alignment scores for each mitigation measure and socio-economic factor - these scores were later aggregated and compared statistically. This characteristic violates the underlying assumption of independence between observations. It also increases type I error, therefore contributing to a higher probability of rejecting null hypotheses when they are actually

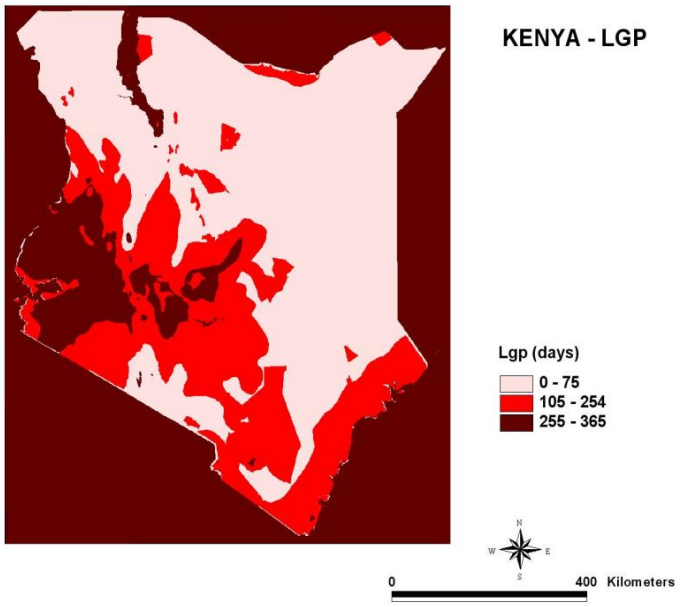

Figure 1. Classification of the country based on the length of the growing period (LGP) (Source: P. Ochungo, ILRI).

true. A mixed effect model was therefore used to account for this correlation; this is described in more detail under Data analysis and Storage.

Framing the questions

Two successive meeting were held to develop the research protocol and questionnaires. The first one was held in Nairobi on 27-30 August 2009 and involved a small working group of researchers. The group recommended that the study concentrate on backyard, small-scale broiler and layer chicken production systems and their associated supply chains to maintain the pro-poor focus of the project. The group also recommended the use of a total of 12 supply chains for each production system, with each supply chain comprising a constellation of chain actors such as producers, traders, transporters and retailers. The meeting also proposed the inclusion of mitigation agents in the study. As noted above, two peacetime preventive measures (biosecurity and reporting) and two outbreak containment measures (culling with compensation and movement control) were identified for evaluation.

The second meeting was convened 28 September-2 October 2009 on the ILRI Nairobi campus to train enumerators and pre-test the questionnaires. During the first two days of the workshop, the project and study objectives were studied and the draft questionnaires reviewed. The enumerators were also trained on how to use eTrex® hand-held Global Positioning System (**GPS**) devices to identify random waypoints and mark positions. The questionnaires were pre-tested towards the end of the training at Wangige area near Nairobi and adjusted based on the observations made. The last day of the training was devoted for developing survey work plans. The training schedule is given in Annex 2.

2.3. Sampling strategy

For each supply chain, 15 random points representing locations of indigenous, layer and broiler chicken farms were generated (Figure 2). Out of the 15 points generated per group, 3 were replacement points to be used when the first 12 could not be accessed. The distributions of the random points for layer and broiler chicken farms were weighted by provincial commercial poultry population estimates. The distribution of the random points for backyard chicken farms was not weighted assuming they are more homogeneously distributed.

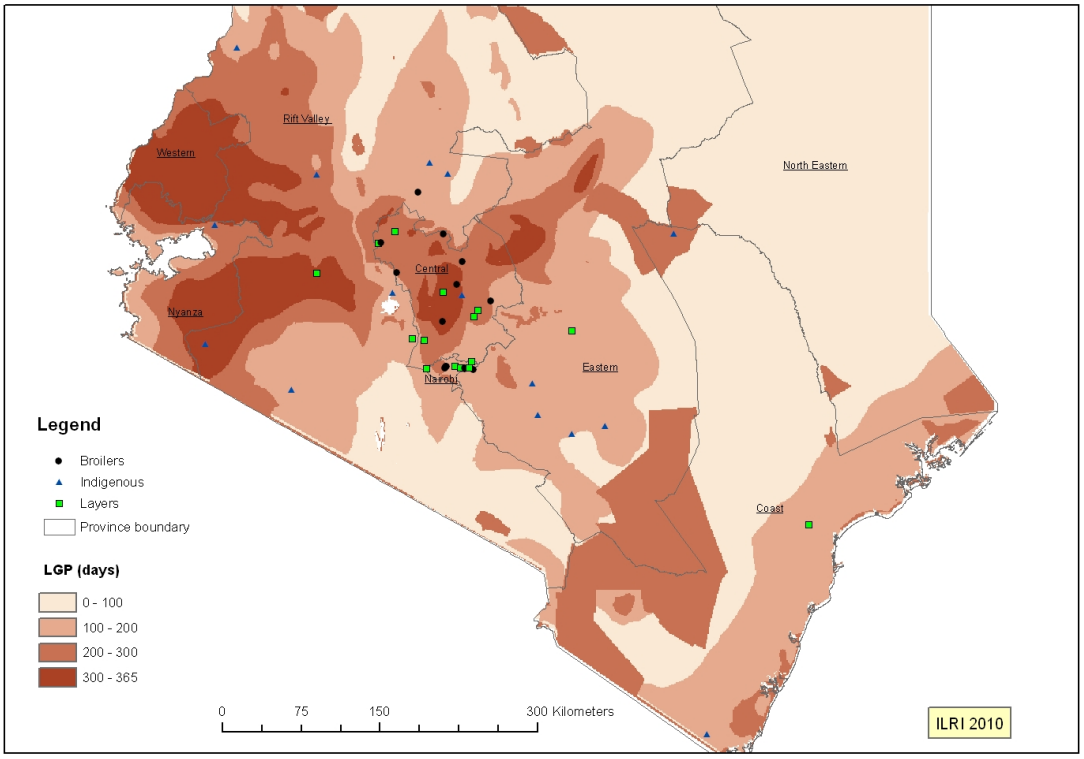

Figure 2. Map of the Kenya showing the distribution of the random waypoints generated as sampling points (Source: P. Ochungo, ILRI).

2.4. Field survey

Field surveys were conducted between 8 November and 1 December 2009. The study sites were classified into four regions and teams of two enumerators were assigned to each region based on their ethnicity so that the enumerators could communicate using local languages when required. District veterinary officers (**DVO**) from each region were notified about the survey and requested to facilitate the visits mainly through making contacts with interviewees and providing directions to the enumerators. The schedule of the visits made is shown in Annex 3.

Random waypoints were uploaded into GPS units which guided the enumerators to the location. Farms that were closest to each waypoint were recruited and their owners or managers interviewed as the first actor in the chicken supply chain. At the end of the interview, the interviewees (actor No. 1) were asked to give contact details of at least three actors who had purchased or collected chickens from their farms in the recent past. Actors being targeted this way included traders,

transporters and local consumers. Actors involved in the most recent transactions were identified, contacted and interviewed as actor No. 2 in the supply chain. If for any reason the most recent actor could not be contacted, the second most recent one was contacted instead. This procedure was repeated until all the actors in the live-chicken supply chain had been identified. Most of the questionnaires were administered in English or Swahili languages except in West Pokot District where a translator was used.

2.5. Data storage and analysis

Data were entered into a database designed using Microsoft ACCESS® and later analyzed using STATA® version 10.0 (STATA Corporation, College Station TX, 2007). Each statement was assigned a numerical code between 1 and 5 depending on the choice given by the respondent and the dimension of the statement made. For example, a choice that strongly affirmed a statement presented in a positive dimension was assigned the highest score of 5 while a choice that strongly opposed the statement got the least score of 1. On the other hand, a choice that affirmed a statement presented in a negative dimension got the least score of 1 and a choice that was strongly opposed to the statement got the highest score of 5. Data from each respondent were then collapsed by socio-economic factors (Practices, Incentives and Capacities) and mitigation measures such that each respondent had three data points for each mitigation measure evaluated. The numbers of Likert items (questions) that were combined to form Likert scales for each factor, mitigation measure and actor are summarized in Annex 4.

A mixed-effects model using the Residual Maximum Likelihood (REML) method was used to evaluate the fixed effects: actor, value chain, socio-economic factor. Random effects were value chain and actor within value chain, to take into account the hierarchical sampling design and allow for non-independence between responses from the same actor and responses from the same value chain. Generally, there was low variation among value chains but significant variation between actors within the same value chain.

Multiple comparisons between levels of the same effect were calculated using a t-value ([mean A – mean B] / s.e.d.), referring to a t-distribution with t degrees of freedom at the actor level. Although information on the effects was available at all levels (value chain, actor, residual) using the actor-level degrees of freedom provided some conservativeness to the test. In addition, a Bonferroni adjustment (significance level=alpha / n where n=number of comparisons) was used to adjust the significance level to reduce the false-positive error rate caused by multiple comparisons.

3. Results

3.1 Evaluation of data collection

Data collection went generally to plan, though a few difficulties were encountered. These included:

- The enumerators often used public transport due to budget constraints. The enumerators, therefore, had to spent more time travelling between sites, especially in the remote areas in the Rift Valley Province (Narok, Kilgoris, Trans Mara, Baringo and West Pokot) and the Eastern Province (Mwingi and Kitui).
- A few DVOs were reluctant to facilitate the work within their administrative units even though they had been requested to help in making contacts with some of the actors such as broiler and layer farms.
- Some of the random points fell in areas that did not have poultry. Such points were replaced with the extra waypoints that had been provided. However, extra time was often required to navigate to the replacement points because they were not necessarily in the same location as the primary points.
- Some of the names of the villages provided with the random waypoints generated using the GIS database did not match with those found on the ground. The enumerators were advised to always use the names obtained on the ground whenever this discrepancy occurred.
- It was always difficult to find time to interview traders and transporters as most of them were often busy at the time of the visit. In a few cases, the enumerators travelled with the transporters and administered the interview in-transit.

3.2 Characterization of supply chain actors and mitigation agents

All actors and agents who were asked to participate in the study complied. The locations of the farms visited are shown in Figure 3.

Backyard (sector 4) chicken producers

Twelve backyard chicken producers aged between 25 and 60 years (average 41 years) were interviewed. Fifty percent (n=6) of them were men and about half of them (55%, n=6/11) were the head of their household. The main source of income for these producers included crop farming (33% of respondents, n=4), livestock farming (25%, n=3) and formal employment (17%, n=2). Others included informal employment and combinations of both livestock and crop farming.

The backyard chicken producers visited also kept other types of livestock including cattle, goats, sheep and pigs, which were evenly distributed across the sample farms (though not confirmed statistically due to the small sample size).

The distribution of the number of chickens kept by these producers is shown in Figure 4. Most of the producers (83%, n=10) kept indigenous chicken breeds.

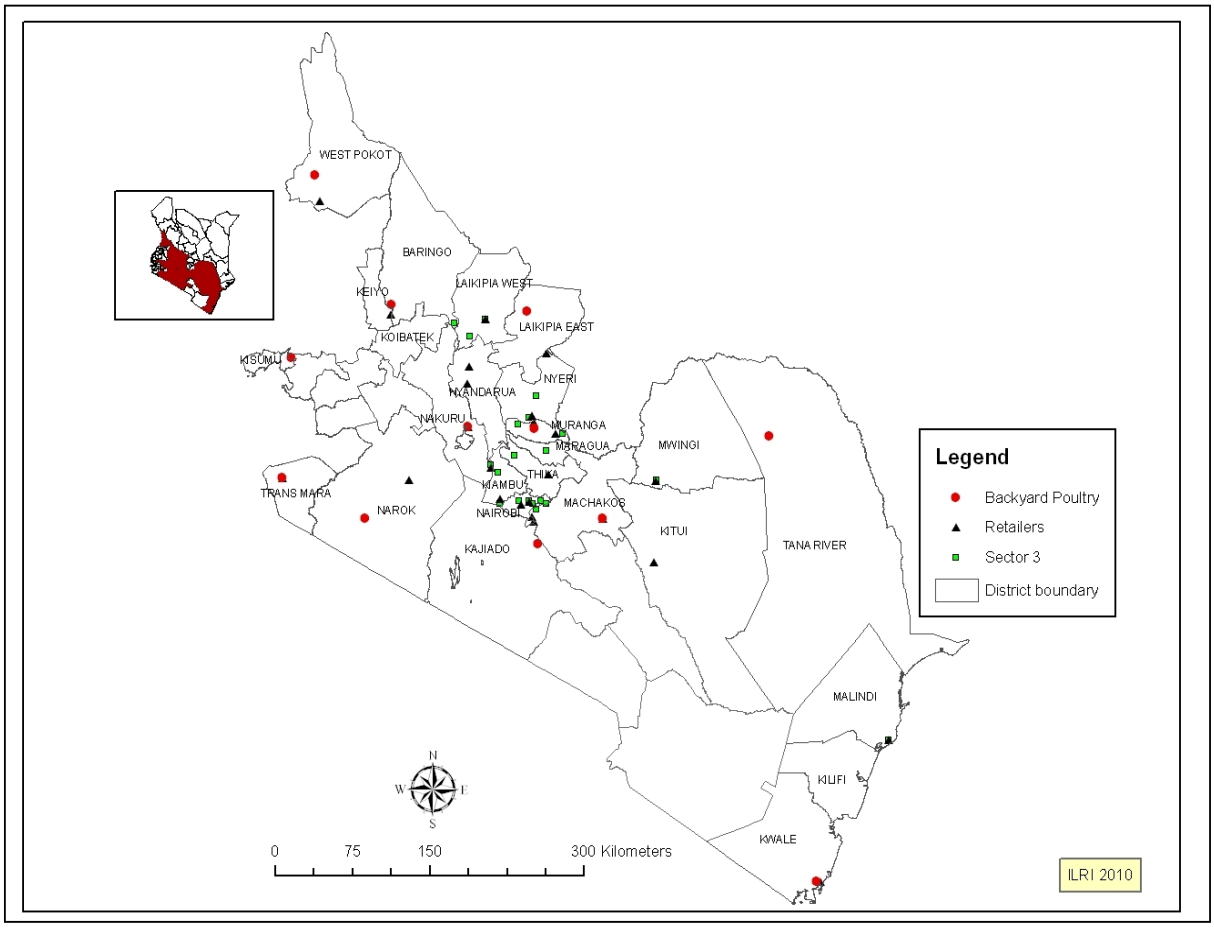

Figure 3. Map of the study area showing the districts selected for the study and the locations of the farms interviewed (Source: P. Ochungo, ILRI)**.**

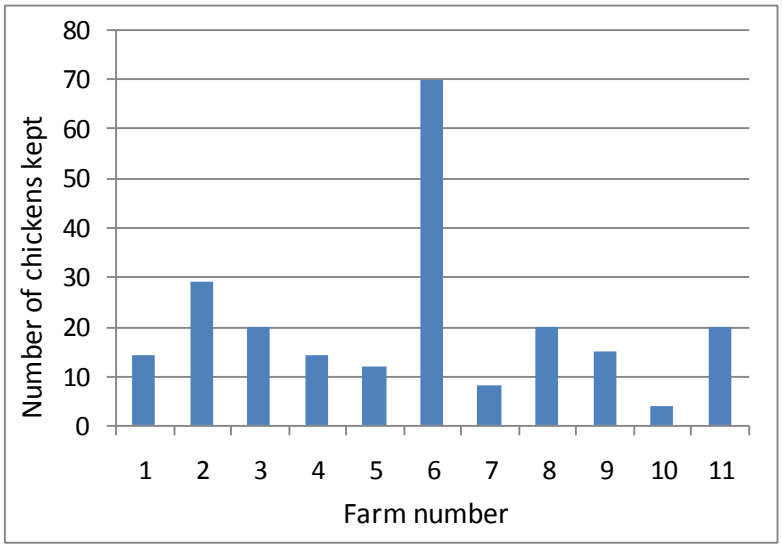

Figure 4. Numbers of chickens kept by backyard chicken producers interviewed in the study

Producers were asked to specify their roles in chicken management. A majority of them (67%, n=8) were involved in daily management activities. The others were responsible for buying inputs, selling chickens or multiple activities ranging from daily management to selling or making decisions on chicken sales. Management practices varied between farms. Half of them (n=6) allowed their chickens to scavenge in the day but enclosed them in a chicken house in the evening. Other types of management included chickens being enclosed in wooden cages (made from papyrus, twigs, etc) in the day and in a chicken house in the night or chickens being allowed to scavenge in the day but enclosed in the cages kept within the living rooms in the evening.

Various ways in which chickens could be sold and whether this was influenced by season were investigated. A majority (67%, n=8) of the respondents preferred to sell their chickens in the market. Others said they sell their chickens to traders who visit their farms or directly to neighbours. Figure 5 summarizes the information obtained on the effects of season on the uses of chickens. It shows that season does not influence the frequency at which chickens are sold, but there is less consumption of chickens and eggs in the wet season, a time when chickens are allowed to breed.

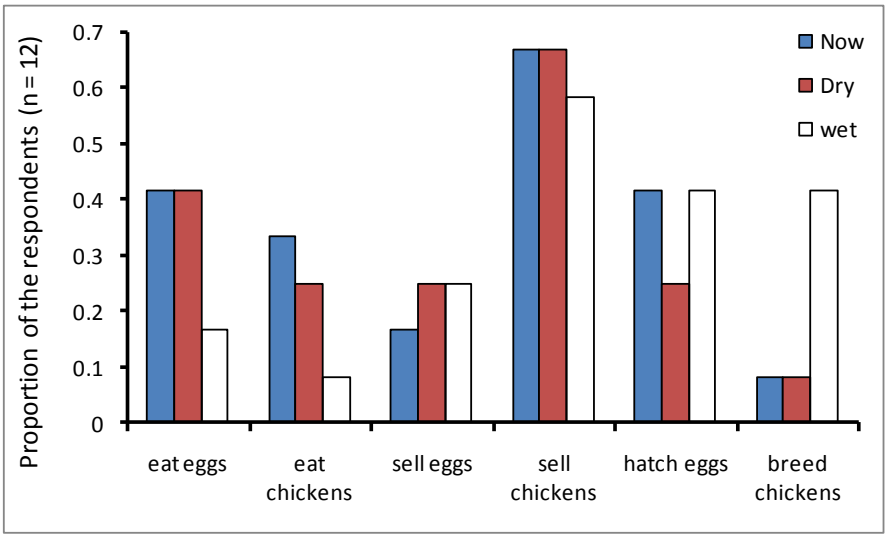

Figure 5. Common uses of chickens and eggs, by season

Small-scale broiler and layer chicken producers (sector 3 producers)

Twenty-one small-scale commercial chicken producers comprising 13 layer and 8 broiler chicken producers were interviewed in the study. Their average age was 43 years with a minimum and maximum age of 20 and 77 years, respectively. Fifty-seven percent (n=12) of them were women. Most (62%, n=13) had been raising poultry for less than 5 years. The other 24% (n=5) and 14% (n=3) had been keeping poultry for a period ranging between 5 and 10 years and over 10 years, respectively. The distributions of the numbers of chickens kept by broiler and layer producers are illustrated by Figures 6 and 7, respectively.

With regard to the type of livestock kept, 33% (n=7) of the producers specialized in chicken production while the rest raised chickens with other livestock species such as cattle, goats, sheep and pigs. For example, 29% (n=6) also raised cattle and goats.

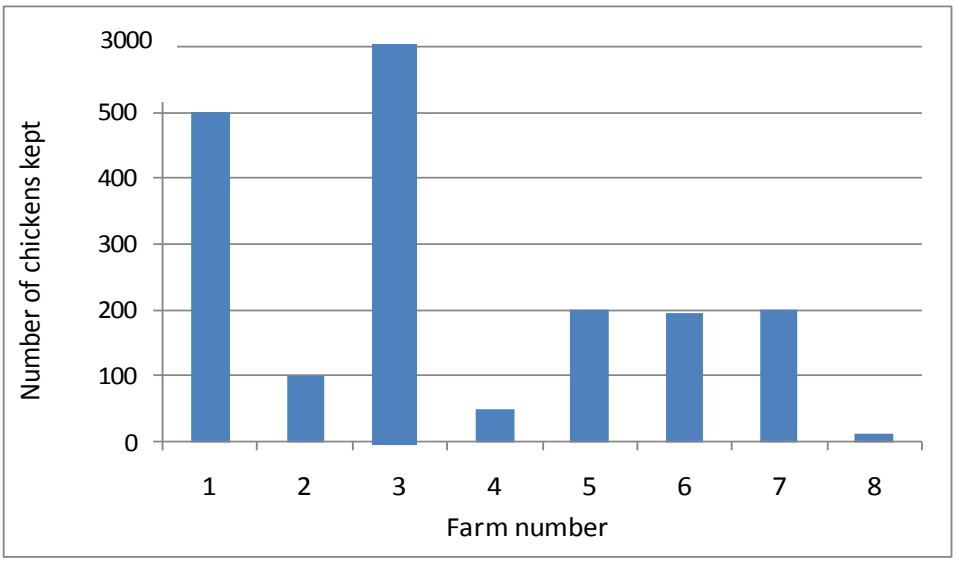

Figure 6. Numbers of chickens kept by each small-scale broiler producer (sector 3) interviewed (the scale of the y axis is broken after Y=500 to accommodate 3000)

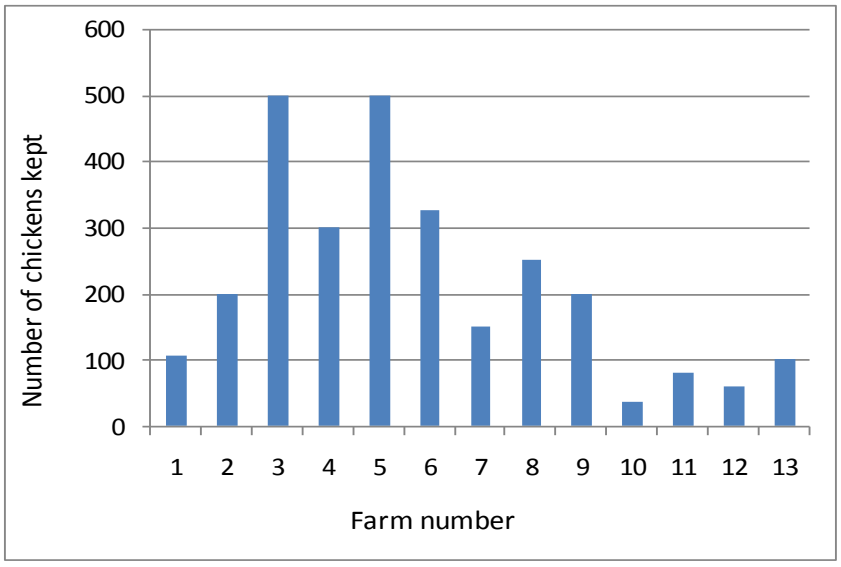

Figure 7. Numbers of layer chickens kept by individual sector 3 poultry producer interviewed

Most of the materials used to build chicken houses were obtained locally. The commonly used flooring material included earth (33%, n=7), cement (33%), wire mesh, iron sheet or wood. The walls were made of tin sheets, wood or chicken wire while the roofs were constructed using tin sheets.

The respondents described various methods by which they sold their live birds. For broilers, 63% (n=5) of the respondents sold live broiler chickens while 38% (n=3) sold dressed chickens. Eighty percent (n = 6) of the producers sold live broilers in a market while the rest sold their birds at the farm gate. Similarly, 62% (n=8) of the layer producers sold live spent layers at the market themselves while 31% (n =4) sold their birds to collectors or traders.

Transporters

All the transporters (n=22) interviewed were men; their ages ranged 20-49 years with a mean of 34 years. Their experience in poultry transportation varied between 1 and 20 years and most of them (67%, n=14) indicated that this business was their main source of income. Forty-five percent of them owned the vehicles they used for transportation. This could be an important factor as it could influence their willingness to implement biosecurity measures such as cleaning and disinfection. Similarly, 45% of the respondents owned poultry but the proportion that owned both poultry and a transport vehicle was only 18% (n=4).

Most of the transporters interviewed (72%, n=16) were engaged in the transportation of poultry or poultry products only. These included spent layers (by 9% of the transporters), broiler and spent layer chickens (14%), indigenous chickens (9%), indigenous and spent layer chickens (5%) and indigenous and broiler chickens (9%). Other products transported included poultry manure, live domestic animals and other agricultural products. Live birds are mainly kept in metal cages (n=6), plastic cages (n=4), boxes (n=2) or baskets (n=2), or tied and piled loosely (n=4).

The majority of transporters (76%) indicated that they did not require a special permit to transport chickens.

Traders

Thirty traders aged between 24 and 60 years (average age of 38 years) were interviewed. They had been trading in poultry and poultry products for 1 to 32 years (an average of 10 years), and 23% were women. A majority of the traders (93%, n=26/28) indicated that poultry trade was their main income generation activity.

The type of products sold by the traders included live and dressed chickens, eggs, other live poultry, live domestic animals, and other agricultural products. Only 13% (n=4) of them traded solely in indigenous chickens and 6% (n=2) only in spent layer chickens. The others sold a mixture of products. These included indigenous, broiler and spent layer chickens (30% [n=9/30] of the traders); indigenous, broiler and spent layer chickens and eggs (16%, n=5/30) and indigenous and spent layer chickens (16%). One other observation made is that traders who sold live domestic animals also traded in indigenous chickens only while those who sold other live poultry such as ducks, geese and turkeys also traded in all the three types of chickens identified above (i.e. indigenous, broiler and spent layers). The lack of specialization in poultry type or products has implications for HPAI control as it influences the degree to which traders can implement biosecurity measures.

Traders were asked to specify ways through which they procured their chickens. The larger proportion of them (40%, n=12) preferred to buy chickens from producers after placing orders, 27% (n=8) purchased chickens from collectors and farmers without any prior arrangements or orders, 10% (n=3) purchased chickens from other traders and 7% (n=2) relied on farmer deliveries. The remaining 16% of the traders procured their stocks using more than one channel. In fact, 7% (n=2) of all the traders used all the four channels described.

A high proportion of traders (46%, n=13) used public service vehicles to transport their products. Only 18% (n=5) used their own or rented vehicles whereas 25% (n=7) used bicycle, carts or motor cycles. While in the market, 43% (n=12) of the traders kept their chickens in wooden cages. A smaller proportion (5%, n=17.9) kept their chickens in other types of cages (mainly plastic), 18% tethered chickens to poles and (14%, n=4) enclosed them in a pen or a room. At the end of the day, slightly

over half (57%, n=12) of the traders kept their chickens in a stall at the market place. The others carried them home (33%, n=7) or enclosed them in a shop at the market place.

Traders were also asked to rank their clients based on the frequency with which they purchased poultry from them. The clients listed in a decreasing order of importance included hotels and schools, retailers, individual customers and other traders.

Retailers

A total of 28 retailers were interviewed. Their ages ranged between 18 and 70 years with a mean of 38 years. The majority (79%, n=22) were men. The duration over which they had been trading in poultry ranged between 1 and 25 years with a mean of 7 years. Most (58%, n=15) indicated that poultry trade was their main activity for generating income.

The products they traded were similar to those described for the traders above. It was common to find retailers selling more than one product at a time. The proportion (18%, n=5) of retailers that traded solely in indigenous chickens was equivalent to those who traded in a mixture of the three types of chickens (indigenous, broiler and layer chickens). Other groups included retailers who traded in indigenous and spent layer chickens (14%, n=3) and indigenous chickens and eggs (11%, n=3). Retailers mainly procured their stocks from producers (29%, n=5), farmers who delivered chickens to the market (21%, n=6) or from a variety of sources such as collectors, farmers and petty traders (21%, n=6).

Most of the retailers (48%, n=14) used public service vehicles to transport their stocks. The other methods of transportation that were commonly used include bicycles or carts (28%, n=8) and own or rented vehicles (17%, n=5). While at the market place, chickens are kept in cages (28%, n=8), a fenced pen (28%), baskets (14%, n=4) or a closed room (14%). On average, a retailer would sell 19 chickens (ranging between 2 and 80) per day. At the end of a market day, most of the traders (46%, n=13) kept unsold chickens in a stall inside the market. Some of them took remaining chickens back home (29%, n=8).

Mitigation agents

Of the 29 agents responsible for implementing HPAI mitigation measures who were interviewed, a large proportion (83%, n=24) of them were men. Most (67%, n=18) had been involved in HPAI activities over a period of 1-2 years while the others had been engaged in these activities for a period of less than 1 year. The distribution of the number of agents interviewed by profession is given in Table 2.

Table 2. The distribution of mitigation agents interviewed by profession

Profession	Number interviewed
Veterinarians (provincial, district or divisional levels)	15
Livestock officers	9
Public health professionals	2
Chief (local administration officers)	2
Laboratory technician	1

The agents were asked to indicate their roles in HPAI control. As expected, almost all the agents were involved in more than one activity. Combinations that had a majority of the agents included:

(i) deployment of preventative measures, deployment of response measures, coordination and information sharing and training for preparedness (31% of the agents, n=9)
(ii) deployment of preventative measures, coordination and information sharing and training for preparedness (17%, n=5)
(iii) deployment of preventative measures, deployment of response measures and training for preparedness (10%, n=3)
(iv) coordination and information sharing and training for preparedness (10%, n=3).

3.3 Analysis of Likert-scale data

Mitigation measures

Table 3 gives an ordered ranking of the mitigation measures based on their overall mean alignment scores given by the value chain actors (with and without transporters) and mitigation agents. Culling is not relevant to transporters because they are expected to have limited authority over their clients' products. They therefore were not asked questions about culling, which creates an imbalance when comparing their mean scores to other actor categories. For this reason, some comparisons include aggregate mean scores with and without transporters included, as in Table 3. In this and the following tables, statistical comparisons of means are indicated by superscripts; a guide on how the superscripts should be interpreted is provided in a note under the table.

Table 3. Mean alignment scores by mitigation measure

Mitigation measure	Value chain actors		Mitigation agents	All actors and agents	
	Including transporters	Excluding transporters		Including transporters	Excluding transporters
Reporting	3.43	3.44	3.83	3.51	3.53
Movement control	3.24^{x}	3.19^{x}	2.77^{x}	3.17^{x}	3.11^{x}
Culling with compensation	3.16^{*x}	3.17^{x}	2.72^{x}	3.08^{*x}	3.09^{x}
Biosecurity	3.15^{x}	3.23^{x}	3.50	3.22^{x}	3.29
F-test Statistic	F=10.89	F=8.47	F=47.96	F= 26.39	F=28.50
p value	*p < 0001*	*p < 0.001*	*p < 0.001*	*p < 0.001*	*p < 0.001*

*Transporters were not asked about culling and compensation, so this score does not include transporters.

Reading down columns, mean scores sharing the same superscript x are not statistically different at α=0.05/n (where n=number of comparisons; Bonferroni correction).

Reporting consistently displays a significantly higher mean alignment score than other measures across the various analyses conducted, whereas both movement controls and culling and compensation feature among the lowest scores.

Supply chain actor

Table 4 gives the overall mean alignment scores by supply chain actor. There was only modest variation between the actor categories, with none of the differences between the categories proving statistically significant.

Table 4. Mean alignment scores by supply chain actor

Actors	Mean score	
	With culling	Without culling
Layer producers	3.45^{x}	3.48^{x}
Broiler producer	3.41^{x}	3.42^{x}
Mitigation agent	3.30^{x}	3.44^{x}
Transporters	3.22*^{x}	3.21^{x}
Retailers	3.26^{x}	3.28^{x}
Traders	3.19^{x}	3.25^{x}
Backyard farmers	3.10^{x}	3.05^{x}
F-test Statistic, *p value*	F= 1.83; *p=0.105*	F=1.79; *p=0.112*

*This score does not include culling and compensation.

Reading down columns, mean scores sharing the same superscript x are not statistically different $\alpha=0.05/n$ (where n=number of comparisons; Bonferroni correction).

Supply chain

The sampled actors (excluding mitigation agents) were identified with three supply chains: broilers, spent layers and indigenous chickens. The overall mean scores for these chains were 3.19, 3.29 and 3.20, respectively; no difference between chains was statistically significant (F=2.80, p=0.06).

Socio-economic factors

The overall mean alignment scores for the socio-economic factors – incentives, practices and capacities -- were 3.40, 3.23 and 3.09, respectively. Each of these means varied significantly from the others (F=29.35; p<0.001); actor incentives were most aligned with compliance, whereas actor capacities were least aligned.

3.4 Analysing mean scores of each mitigation measure by supply chain, actor and socio-economic factor

In this section, alignment scores of each mitigation measure were analysed separately by supply chain, actor and socio-economic factor.

Biosecurity

Chain-level analysis

Table 5 presents mean alignment scores for each supply chain by socio-economic factor. The results show no significant variation in the mean alignment scores by supply chain. The mean score for actor capacities was however significantly lower than those for actor practices and incentives, which were

similar. This reflects the low capacity of actors to access information and to afford investments required to implement biosecurity.

Table 5. Mean scores for biosecurity by supply chain

Chicken supply chain	Practices Score	Capacities Score	Incentives Score	Mean Score	F-test Statistic (S-E Factor) *p value*
Broiler chicken	3.27 [a,x]	2.64 [x]	3.48 [a,x]	3.13 [x]	
Indigenous chicken	3.20 [a,x]	2.73 [x]	3.37 [a,x]	3.10 [x]	
Spent layer	3.43 [a,x]	2.79 [x]	3.43 [a,x]	3.22 [x]	
Mean score	3.30 [a]	2.72	3.42 [a]	3.15	64.09
					<0.001
F-test Statistic (chain)				0.49	0.86*
p value				*0.615*	*0.489*

Mean scores (across rows or down columns) sharing the same superscript a (rows) or x (columns) are not statistically different α=0.05/n (where n=number of comparisons; Bonferroni correction).

*F-test Statistic for interaction between supply chain and socio-economic factor.

Actor-level analysis

Broiler and layer farmers both exhibit mean alignment scores at the high end of the range for the various actor categories, but these were only significantly higher than the score for transporters (Table 6). Sector 3 producers are therefore clearly more aligned with the requirements for successful implementation of biosecurity measures than transporters.

With mitigation agents taken into account in Table 6 (note that they are not included in the calculations in Table 5), incentives emerge as the most aligned set of socio-economic factors, and capacities the least, across the actors.

When small-scale broiler and layer farmers were asked to give reasons why they were willing and able to implement biosecurity measures, including confining their chickens, they said that they were interested in (i) avoiding losses and minimizing stress to their chickens from noise, (ii) preventing diseases, (iii) ensuring good health and growth of their birds, and (iv) that they could get subsidized construction materials to build chicken houses. Transporters, on the other hand, indicated that they were not willing or able to implement improved biosecurity measures because that required time, the measures were expensive and there was no adequate information on disinfectants. They further said that they did not separate chickens from different sources while transporting them in order to maximize space, and so were able to carry many more chickens per consignment. Retailers gave similar reasons as the transporters for not being able to implement these measures, i.e. that the measures were costly, and they lacked space to separate chickens and had no information on biosecurity practices. The reasons given by backyard chicken farmers for not being able to enclose chickens were: (i) lack of funds to buy feed, (ii) lack of funds to construct holding facilities and (iii) ignorance about the benefits of enclosing chickens.

Table 6. Mean scores for biosecurity by supply chain actor

Supply chain actor	Practices Score	Capacities Score	Incentives Score	Overall Mean Score	F-test Statistic (S-E Factor) *p value*
Backyard chicken producer	2.98^{a,b,x}	2.67^{a,x}	3.63^{b,x}	3.09^{x,y}	
Broiler chicken producer	3.48^{x}	3.49^{x}	3.90^{x}	3.62^{y}	
Layer chicken producer	3.62^{x}	3.20^{x}	3.86^{x}	3.56^{y}	
Trader	3.46^{a,x}	2.62^{x}	3.32^{a,x}	3.13 ^{x,y}	
Retailer	3.31^{a,x}	2.71^{x}	3.33^{a,x}	3.12 ^{x,y}	
Transporter	3.03^{a,x}	2.42^{x}	3.05^{a,x}	2.83 ^{x}	
Mitigation agent	3.41^{a,b,x}	3.26^{a,x}	3.83^{b,x}	3.50 ^{x,y}	
Mean score	3.33^{a}	2.91^{b}	3.56^{c}	3.27	64.20
					<0.001
F-test Statistic (actor)				4.32	2.36*
p value				*<0.001*	*0.007*

Mean scores (across rows or down columns) sharing the same superscript a, b or c (rows), x or y (columns) are not statistically different α=0.05/n (where n=number of comparisons; Bonferroni correction).

*F-test Statistic for interaction between supply chain actor and socio-economic factor

Reporting

Chain-level analysis

Table 7 gives mean alignment scores for complying with reporting HPAI by supply chain. Mean scores did not vary significantly by chain but they varied significantly by factor: actor practices had significantly lower mean score than those of capacities and incentives. Many actors are currently either unaware of reporting requirements or reluctant to do so.

Actor-level analysis

The alignment score for reporting for backyard chicken producers fell at the lower end of the range among the actors, significantly lower than those of the traders, retailers and mitigation agents (Table 8). The score for mitigation agents features at the high end of the range for reporting.

Mitigation agents interviewed said they were willing and able to report disease outbreaks because:

(i) surveillance and capacity building was their core function
(ii) of their interest to prevent disease and protect poultry
(iii) they had transport and staff to do surveillance
(iv) they could get refunded for the expenses they incurred
(v) of their interest to make their area free of disease and
(vi) of their obligation to enhance the performance of their department.

Table 7. Mean scores for reporting by supply chain

Chicken supply chain	Practices Score	Capacities Score	Incentives Score	Overall Mean Score	F-test Statistic (S-E Factor) *p value*
Broiler chicken	3.08[a,x]	3.60[a,x]	3.48[a,x]	3.39[x]	
Indigenous chicken	3.24[a,x]	3.31[a,x]	3.47[a,x]	3.34[x]	
Spent layer	3.36[a,x]	3.62[a,x]	3.62[a,x]	3.53[x]	
Mean score	3.23	3.51[a]	3.52[a]	3.42	7.33
					<0.001
F-test Statistic (chain)				1.50	1.14*
p value				*0.239*	*0.338*

Mean scores (across rows or down columns) sharing the same superscript a (rows) or x (columns) are not statistically different α=0.05/n (where n=number of comparisons; Bonferroni correction).

*F-test Statistic for interaction between supply chain actor and socio-economic factor

Table 8. Mean scores for reporting by supply chain actor

Supply chain actor	Practices Score	Capacities Score	Incentives Score	Overall Mean Score	F-test Statistic (S-E Factor) *p value*
Backyard producer	2.63[a,x]	2.71[a,x]	3.40[a,x]	2.91[y]	
Broiler chicken producer	2.59[a,x]	3.82[b,x,y]	3.41[a,b,x]	3.27[x,y]	
Layer chicken producer	2.83[a,x]	3.45[a,x,y]	3.53[a,x]	3.27[x,y]	
Trader	3.72[a,y,z]	3.59[a,x,y]	3.49[a,x]	3.60[x]	
Retailer	3.36[a,x,y]	3.85[a,y]	3.60[a,x]	3.60[x]	
Transporter	3.39[a,x,z]	3.23[a,x,y]	3.62[a,x]	3.41[x,y]	
Mitigation agent	4.22[a,z]	3.42[b,x,y]	3.86[a,b,x]	3.83[x]	
Overall mean score	3.25	3.44[a]	3.56[a]	3.41	3.21
					0.042
F-test Statistic (actor)				4.08	9.14*
p value				*0.006*	*<0.001*

Mean scores (across rows or down columns) sharing the same superscript a, b (rows) or x, y or z (columns) are not statistically different α=0.05/n (where n=number of comparisons; Bonferroni correction).

*F-test Statistic for interaction between supply chain actor and socio-economic factor

Backyard chicken producers said that they were not willing or able to report disease outbreaks, especially when the cause of the outbreaks was known. They also indicated that lack of knowledge, illiteracy, lack of transport and lack of awareness about whom to report the outbreaks to discouraged them from giving reports. Traders said they feared the consequences of reporting outbreaks such as being barred from making further sales or being asked to cull their birds. They also said they did not expect to get help by giving the reports (i.e. reporting did not result in immediate action that would protect their stocks).

Movement control

Chain-level analysis

The overall mean scores for movement control did not significantly vary by chain (Table 9). The mean scores for socio-economic factors however varied significantly from each other. Although value chain actors generally have a higher level of motivation to comply with movement control measures, doing so requires a significant change from their current practices and is particularly constrained by weak capacity.

Table 9. Mean scores for movement control by supply chain

Supply chain	Practices Score	Capacities Score	Incentives Score	Overall Mean Score	F-test Statistic (S-E Factor) *p value*
Broiler chicken	3.27 ^{a,x}	2.86 ^{a,x}	3.51 ^{a,x}	3.21 ^{x}	
Indigenous chicken	3.10 ^{a,x}	3.04 ^{a,x}	3.39 ^{a,x}	3.17 ^{x}	
Spent layer	3.27 ^{a,b,x}	2.96 ^{a,x}	3.69 ^{b,x}	3.30 ^{x}	
Mean score	3.21 ^{a}	2.95 ^{b}	3.53 ^{c}	3.23	22.09
					<0.001
F-test Statistic (chain)				0.50	1.22*
p value				*0.610*	*0.302*

Mean scores (across rows or down columns) sharing the same superscript a, b, c (rows) or x (columns) are not statistically different α=0.05/n (where n=number of comparisons; Bonferroni correction).

*F-test Statistic for interaction between supply chain actor and socio-economic factor

Actor-level analysis

Mitigation agents and traders had the lowest mean alignment scores for movement control compared to those of the value chain actors, but these were only significantly lower than for layer producers (Table 10). The alignment score for layer chicken producers and transporters were at the high end of the range, presumably because both have more flexibility when movement controls are imposed: layer producers can keep their layers in egg production, whereas transporters can find other goods to transport.

Small-scale broiler and layer producers said they would support the implementation of movement controls especially if the disease being controlled was severe. They also stated that they would implement this measure to (i) prevent disease spread, (ii) protect human exposure, (iii) if

Table 10. Mean scores for movement control by supply chain actor

Supply chain actor	Practices Score	Capacities Score	Incentives Score	Overall Mean Score	F-test Statistic (S-E Factor) *p value*
Backyard chicken producer	3.18 ^{a,x,y}	3.17 ^{a,x}	3.03 ^{a,x}	3.13 ^{x,y,z}	
Broiler chicken producer	3.69 ^{a,x,y}	2.73 ^{a,x}	3.58 ^{a,x}	3.33 ^{x,y,z}	
Layer chicken producer	4.23^{b,y}	2.98 ^{a,x}	3.71 ^{a,b,x}	3.64 ^{z}	
Trader	2.67^{a,x}	2.92 ^{a,x}	3.46 ^{b,x}	3.02 ^{x}	
Retailer	2.92^{a,x}	2.77 ^{a,x}	3.72 ^{b,x}	3.14 ^{x,y,z}	
Transporter	3.50 ^{a,y}	3.27 ^{a,x}	3.57 ^{a,x}	3.45 ^{y,z}	
Mitigation agent‡	-	2.73 ^{a,x}	2.80 ^{a,x}	2.77 ^{x,y}	
Mean score	3.37 ^{a}	2.94 ^{b}	3.41^{a}	3.22	23.54
					<0.001
F-test Statistic (actor)				4.49	6.75*
p value				*<0.001*	*<0.001*

Mean scores (across rows or down columns) sharing the same superscript a or b (rows) or x, y or z (columns) are not statistically different α=0.05/n (where n=number of comparisons; Bonferroni correction).

*F-test Statistic for interaction between supply chain actor and socio-economic factor

‡Practices not included in this evaluation because mitigation agents relied on the police and other actors to implement movement controls

compensated, (iv) to comply with the government regulations and (v) if the other producers complied as well. The reasons given by the mitigation agents for not being able to implement movement controls included lack of adequate compensation (i.e. allowances), lack of transport, poor coordination with other relevant departments and that traders would still find ways of violating the controls. Traders said they would evade quarantine measures if they did not have other sources of income, when their chickens were not sick or if they did not have adequate information about the purpose of the movement controls implemented.

Culling and compensation

Chain-level analysis

The overall mean alignment scores for culling and compensation did not vary by chain (Table 11). On the other hand, incentives scores were significantly higher than those of practices and capacities.

Actor-level analysis

Alignment scores for the three types of chicken producers ranged higher for culling and compensation than other actor categories although these were only significantly different from the low score characterizing mitigation agents (Table 12). Again, the actors collectively displayed a significantly higher mean score for incentives than the other socio-economic factors.

Table 11. Mean scores for culling and compensation by supply chain

Value chain	Practices Score	Capacities Score	Incentives Score	Overall Mean Score	F-test Statistic (S-E Factor) *p value*
Broiler chicken	2.75[a,x]	2.95[a,b,x]	3.66 [b,x]	3.12 [x]	
Indigenous chicken	2.84[a,x]	3.07[a,x]	3.66[b,x]	3.19 [x]	
Spent layer	2.92[a,x]	2.93[a,x]	3.64 [b,x]	3.16 [x]	
Mean score	2.84[a]	2.98[a]	3.65 [b]	3.16	37.46
					<0.001
F-test Statistic (chain)				0.13	0.32*
p value				*0.877*	*0.862*

Mean scores (across rows or down columns) sharing the same superscript a or b (rows) or x (columns) are not statistically different α=0.05/n (where n=number of comparisons; Bonferroni correction).

*F-test Statistic for interaction between supply chain actor and socio-economic factor

Table 12. Mean scores for culling and compensation by value chain actor

Actor	Practices Score	Capacities Score	Incentives Score	Overall Mean Score	F-test Statistic (S-E Factor) *p value*
Backyard chicken producer	2.98 [a,x]	3.31[a]	3.57 [a,x]	3.29 [x]	
Broiler chicken producer	2.98 [a,x]	3.26 [a]	3.84 [a,x]	3.36 [x]	
Layer chicken producer	2.95 [a,x]	3.34 [a]	3.73 [a,x]	3.34 [x]	
Trader	2.71[a,x]	2.74 [a]	3.51[b,x]	2.99 [x,y]	
Retailer	2.89 [a,x]	2.87 [a]	3.75 [b,x]	3.17 [x,y]	
Mitigation agent[‡]	-	3.03 [a]	2.41[a]	2.72 [y]	
Mean score	2.90 [a]	3.10 [a]	3.47 [b]	3.15	24.42
					<0.001
F-test Statistic (actor)				3.89	5.62*
p value				*0.015*	*<0.001*

Mean scores (across rows or down columns) sharing the same superscript a or b (rows) or x or y (columns) are not statistically different α=0.05/n (where n=number of comparisons; Bonferroni correction).

*F-test Statistic for interaction between supply chain actor and socio-economic factor

[‡]Practices not included in this evaluation because mitigation agents relied on the police and other actors to implement culling

Small-scale layer and broiler producers said that they would be willing and able to implement culling and compensation to comply with government regulations, protect their family members from being exposed to zoonotic diseases and control disease outbreaks. They also said their participation in the exercise would depend on the severity of the disease. Mitigation agents, on the other hand, said they were not willing to implement culling and compensation because they feared that producers and traders would not cooperate and that there were insufficient resources such as transport, staff and allowances required for the work. Traders said they would not comply with the measure because they did not trust that the government would compensate them adequately and in a timely manner and that chicken trade was their only source of income. They also said that they saw no sense in the requirement to include apparently healthy chickens in culling.

Comparing different actors' perception of alignment

All of the respondents were asked to evaluate the degree of alignment between the implementing agents' characteristics and the requirements for effective implementation of movement controls. The set of Likert statements used covered the same general issues, but the specific issues and wording were adapted to the specific context for each actor category, so are notionally though not strictly comparable.

In general, mitigation agents' self-evaluation of their capacities (2.73; 95% CI: 2.48-2.98 versus 3.23; 95% CI: 3.11-3.37) and incentives (2.80; 95% CI: 2.65-2.96 versus 3.11; 95% CI: 3.01-3.21) were significantly lower than the mean score across supply chain actors ($p<0.001$). Table 13 shows a comparison of overall mean scores of individual actors and those of the agents; this comparison indicates that there is no significant difference between them.

The reasons given by small-scale layer and broiler chicken producers, backyard chicken producers, traders and transporters for mitigation agent willingness to implement movement controls were very similar. They indicated that the agents saw this as an opportunity to earn extra allowances in addition to preventing diseases in poultry. The actors stated that the agents implemented movement controls in order to fulfill their mandates and earn promotion. In addition, the actors said the agents enjoyed cooperation from producers and traders and some of them raised poultry and they would want to be seen to be doing the right thing. The reasons that the actors gave for agents' unwillingness to implement the measure included (i) corruption (and that they accepted bribes), (ii) insufficient resources (transport, allowances), (iii) lack of supervision, (iv) irresponsibility, (v) underpayment and (vi) lack of rewards for good service.

Similarly, mitigation agents were asked to give their perception of the degree of alignment with the requirements for implementing movement controls for one specific actor category: sector 3 farmers (Table 14). In this case, the mitigation agents scored the sector 3 producers lower for practices (3.28; 95% CI: 3.06, 3.50 versus 4.02; 95% CI: 3.71, 4.34) and incentives (3.29; 95% CI: 3.06 – 3.53 versus 3.65; 95% CI: 3.41, 3.90) than the producers' own self assessment; the differences were statistically significant ($p <0.001$ versus $p=0.03$). Their respective assessments were closer, however, regarding producers' capacities to implement movement control ($p=0.71$). Overall, mitigation agents gave a significantly lower mean score for the sector 3 producers' degree of alignment with requirements for movement controls than did the producers when assessing themselves (3.18, 95% CI: 3.04-3.31 versus 3.52, 95% CI: 3.31-3.73; $p = 0.004$).

The agents indicated that small-scale broiler and layer chicken producers were willing to implement movement controls to minimize losses, control spread of the disease and avoid penalties, and that

inputs, mainly feed, were provided free of charge during quarantine periods to act as an incentive for producers to keep chickens past the marketing age. They also said that lack of strict regulations and information could encourage these farmers to violate movement restrictions during quarantine.

Table 13. Mean scores for the alignment of mitigation agents with implementation of movement control as perceived by different actor categories

Actor	Capacities Score	Incentives Score	Overall Mean Score	T-test Statistic (S-E Factor) *p value*
Mitigation agent (self)	$2.73^{a,x}$	$2.80^{a,x}$	$2.77^{x,y}$	
Backyard farmer	$3.01^{a,x}$	$3.35^{a,x}$	$3.17^{x,y}$	
Broiler farmer	$3.02^{a,x}$	$2.56^{a,x}$	$2.79^{x,y}$	
Layer farmer	$2.91^{a,x}$	$2.81^{a,x}$	2.87^{x}	
Trader	$3.23^{a,x}$	$3.10^{a,x}$	$3.16^{x,y}$	
Retailer	$3.41^{a,x}$	$3.13^{a,x}$	$3.27^{x,y}$	
Transporter	$3.42^{a,x}$	$3.35^{a,x}$	3.39^{y}	
Mean score for supply chain actors	3.11^{a}	3.01^{a}	3.06	1.97 *0.163*
F-test Statistic (actor)			3.45	
p value			*0.005*	

Mean scores (across rows or down columns) sharing the same superscript a (rows) or x or y (columns) are not statistically different α=0.05/n (where n=number of comparisons; Bonferroni correction).

*F-test Statistic for interaction between supply chain actor and socio-economic factor

Table 14. Mean scores for the alignment of sector 3 producers with implementation of movement control, self-evaluation and as perceived by implementing agents

As perceived by :	Practice Score	Capacity Score	Incentive Score	Overall Mean Score	F-test Statistic (S-E Factor) *p value*
Broiler chicken producer (self)	$3.69^{b,x}$	$2.73^{a,x}$	$3.58^{a,b,x}$	3.33^{x}	
Layer chicken producer (self)	$4.23^{a,x}$	$2.99^{b,x}$	$3.71^{a,x}$	3.64^{x}	
Mitigation agents	$3.28^{a,x}$	$2.96^{a,x}$	$3.29^{a,x}$	3.18^{x}	
Mean score for actors	4.02^{a}	2.89^{b}	3.65^{a}	3.38	24.68 *<0.001*
F-test Statistic (actor)				2.23	4.69*
p value				0.107	<0.001

Mean scores (across rows or down columns) sharing the same superscript a (rows) or x or y (columns) are not statistically different α=0.05/*n* (where *n*=number of comparisons; Bonferroni correction).

*F-test Statistic for interaction between supply chain actor and socio-economic factor – for this analysis F-test was approximated by Wald test statistic as small *n*.

4. Discussion

4.1 Evaluating the approach

The contingency measures developed in Kenya following the outbreak of the Asian lineage HPAI in Asia and then Europe listed a range of mitigation measures that would be implemented for early detection, prevention and control of the disease (Ministry of Livestock Development [**MoLD**] 2008). The measures identified include surveillance, enhanced biosecurity, movement control, culling and compensation, changes in industry practices aimed at reducing risk, vaccination and risk communication. Although the country has never been exposed to the disease, there is still uncertainly about how the proposed interventions would be implemented and whether they would be effective. Such fears are related to (i) uncertainty about the epidemiology of the disease; (ii) constrained capacity by the relevant departments to implement control; and (iii) variable compliance by the relevant actors, mainly in the poultry sector. This study addresses the last point. It uses a value chain model to identify the various actors who would be expected to implement the control measures as well as the mitigation agents who would deliver them. The study focused on live-chicken supply chains and assessed four main HPAI mitigation measures, namely reporting, biosecurity, movement control and culling and compensation. The premise behind this approach is that actor willingness to comply depends on the alignment of control measures with actor capacity to comply, their current practices and incentives they face.

The various ways in which actor capacities, incentives and practices would influence the implementation of each mitigation measure were described. This was achieved by listing (i) various measures or activities that actors would be expected to implement to control the disease that would be different from their current activities (under practices); (ii) financial, human, and informational resources that would be required (as capacities); and (iii) reasons—financial or otherwise, that would motivate an actor to want to control the disease (incentives). These descriptions were converted into a series of statements or questions with Likert scales to measure intensity and direction of attitudes or perceptions. The answers given were scored such that a high score would indicate strong alignment with the control measure and a low score, weak alignment. The scores obtained were analysed using a linear mixed model whose variance components were estimated using restricted maximum likelihood method.

The Likert scale technique applied in this study has been widely applied in marketing research to measure attitudes, images and opinions (Albaum 1997; Wu 2007). In this study, a five-point scale comprising both one-dimensional choices (e.g. always to never and likely to unlikely) and bipolar choices (e.g. strongly agree to strongly disagree) was considered appropriate. The number of choices used, however, can influence the accuracy of information obtained; an odd number of choices is thought to allow interviewees to sit on the fence while an even number forces the respondents to make a decision (http://changingminds.org/explanations/research/measurement/likert_scale.htm).

The challenges encountered in the study were mainly related to the development and administration of the questionnaires, identification of the actors and analysis of the data. Likert questionnaires were developed based on the list of indicators arrived at through consultations with local and international experts. It was not possible to know whether the list of indicators developed and used in framing the questions was exhaustive or whether the Likert scales were presented with clarity for the interviewees to make appropriate choices. With regard to the identification of actors,

it was a challenge to find small-scale layer or broiler chicken producers especially in low potential areas such as West Pokot, Kitui and some parts of the Rift Valley Province. In addition, given the infrequency of their sales, some backyard chicken producers could not recall contact details for traders who purchased chickens from them. In such cases, alternative traders who purchased chickens from the village where such producers lived were identified in the local market and interviewed. Such modifications in the design might have introduced selection bias.

The number of indicators and associated Likert statements varied by combination of mitigation measure, socio-economic factor and category. Mean scores were therefore used to compare the degree of alignment of mitigation measures instead of the summative scores that are often used to analyse Likert scale responses. The mean scores obtained from the study however clustered largely between 2.7 and 3.5 and it is not clear whether this trend reflects the natural tendency of the respondents to avoid extreme positions or the fact that mean scores have their own statistical distribution.

4.2 Implications for policy

Which mitigation measures are likely to enjoy better compliance and therefore achieve the expected technical effectiveness?

The analysis of the Likert scale data summarized in Table 3 shows that reporting is most strongly aligned with practices, capacities and incentives of both value chain actors and mitigation agents. This measure is likely to be implemented successfully since it had the highest mean alignment score from both supply chain actors and mitigation agents. Conversely, culling and compensation had the least mean alignment score although this score was not significantly different from those of biosecurity and movement control. Mitigation agents gave movement control the second lowest mean alignment score. It is therefore expected that it would be difficult to implement culling and compensation and movement control unless their fail points are addressed.

For each control measure, where do potential compliance fail-points appear to lie and how might they be addressed?

Reporting: The results show that the requirements for effective reporting were least aligned with the socio-economic characteristics of backyard chicken producers (fail-point with respect to reporting). Backyard chicken farmers often lack technical support and infrastructure to detect and report disease. They also experience periodic die-offs due to sporadic disease outbreaks such that they may not pay much attention to major disease outbreaks when they occur despite being aware of such outbreaks. This is reflected in the low alignment scores they gave for their practices and capacities to report. These actors, however, identified incentives for reporting that can be used as entry points when addressing the existing attitudes against reporting. There is a need to create and disseminate behavioural change messages targeting these specific attitudes, together with sufficiently severe penalties when failure to report can be established. There is also need to develop a reliable infrastructure for reporting such as the use of toll-free mobile phone numbers as well as an effective response system. Lack of response discourages actors from participating in a surveillance system.

Biosecurity: This study identifies transporters as the primary fail-point with respect to measures to improve biosecurity. Transporters, together with traders, retailers and backyard chicken producers

indicate that they lack the required capacity to implement effective biosecurity measures. Capacity in this context relates to access to information, financial, and human resources, recognizing that uptake of improved biosecurity practices requires awareness and understanding of the benefits of compliance together with significant financial and time investments. Examples of interventions that are required, therefore, range from enhancing the understanding of biosecurity measures through targeted communication preferably via transport/trader/farmer organizations to subsidizing some of the costs. Improving enforcement of regulations that confer legal liabilities for biosecurity breaches when they can be demonstrated can also be considered, but needs to be carefully weighed against the capacity constraints and realities faced by the enforcement agencies.

Movement control: This study shows that traders and mitigation agents are the suspected fail-points with respect to the implementation of movement controls. For traders, low compliance is related mainly to engagement with high-risk practices such as failure to observe movement restrictions and buying or selling chickens in quarantined areas. Designing movement controls that still allow transport of chickens under certain conditions to avoid unreasonable catastrophic losses might create appropriate incentives to counter such practices.

For mitigation agents, this is related both to weak incentives and to inadequate capacity to implement movement controls due to lack of staff, transport and other equipment as well as for inefficient coordination between different departments. This is an interesting observation when compared to the responses given by these agents on their willingness and ability to report cases. This shows that the disease control officers are given more incentives to identify and report cases than respond to them. It will be necessary for the departments that are expected to implement movement controls to allocate more financial and capital resources to be able to implement and monitor movement controls. There is also a need for a more coordinated approach between the relevant departments such as the police, Department of Veterinary Service (**DVS**), public health and the local/municipal authorities.

Culling and compensation: Culling and compensation is least aligned with trader and mitigation agent willingness to comply; they are therefore regarded as fail points for the implementation of this measure. Attempts have were made to develop a culling and compensation implementation policy in Kenya as part of the National Avian Influenza Action Plan but the policy is yet to be finalized. The focus has always been on building the capacity of the MoLD and DVS to implement this intervention when called upon, as well as finding an efficient system for paying out compensation to farmers. This study indicates, however, that current practices of most supply chain actors, particularly traders, are not aligned with the requirements for implementing culling and compensation since actors generally try to avoid participation in culls, so attention must also be invested in the actors, not just the implementing agents. Communication campaigns to raise awareness among the various actors of the rationale and benefits of culling will be essential to improving compliance, especially in situations where outbreaks are prolonged and challenge the capacity of public finances to sustain compensation. Engaging with the various actors in the design of compensation policies would serve to enhance their buy-in in such instances as well. Ensuring timeliness and transparency in the administration of the compensation appears to have contributed to better compliance in countries where outbreaks have occurred. Assessing the need for compensation of actors in the value chain beyond the producer on-farm should also be considered.

5. Key messages

- Reporting is expected to achieve a high degree of compliance from chicken supply chain actors (sectors 3 and 4) and mitigation agents, and measures aimed at improving reporting practices, especially for backyard chicken producers, are expected to have positive impact. Conversely, culling and compensation will not achieve sufficient levels of compliance across the various actors unless measures to address weaknesses in culling practices and capacities generally are designed and implemented.
- Transporters emerge as the potential fail-points for compliance with better biosecurity measures. Transporters, and to a lesser extent traders, retailers and backyard chicken producers, do not have adequate capacity to implement such measures. Some of the actions that can be taken to improve their capacities include improving access to informational, financial and human resources through training and improving access to micro-credit services.
- Poor compliance with movement control can be attributed to weak alignment with existing practices, mainly with traders, as well as weak capacity among mitigation agents. Attention needs to be focused on improving the capacity of the agencies that implement movement controls. It would be useful to consider also adjusting movement control policies to allow for transport of chickens under certain conditions to minimize losses which actors attempt to avoid, as well as raising public awareness about why movement controls are needed.
- Existing practices for most actors of the chicken supply chain, particularly traders, are not aligned with requirements for implementing culling and compensation. Public awareness communication strategies and using a participatory process to develop the culling and compensation policy might improve actor ownership and cooperation, especially when public finances are not able to sustain adequate compensation in extended outbreaks. More research is also needed in this area to determine the most effective way of implementing the measure, including the degree to which timeliness and transparency of compensation promote better compliance.

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Annex 1. Enumerator manual for sector 3 producer questionnaire

Enumerator Manual

Sector 3 Producer Questionnaire

This questionnaire is intended for small-scale commercial producers of broilers and layer operations who usually keep 100-5000 birds at any one time. One producer will be identified and interviewed per sampling point. The producer will be selected by locating the nearest trading centre to the sampling point and consulting local key informants to identify the nearest chicken farms and amongst these, the one closest to the sampling point.

Once identified, ask for the farm manager, introduce yourself and the project

Introduction

I am ____ from a research organization based in Nairobi and we are doing a study on poultry. The information we will collect in this exercise will help us advise the government on what to do in case a disease such as bird flu occurs. We are not going to reveal your identity and responses but the responses you give us will be combined and reported with those of others as a group.

(this is a voluntary exercise and you are free to decline participation). Can you spare a few minutes to answer the questions we have for you?

This is a survey on poultry husbandry and we will be asking more questions on methods used to prevent or control bird flu

- **the information will help us to advise the government on which types of measures are likely to work well in stopping disease spread if there is an outbreak of avian flu (or other), and which won't in terms of producers being willing and able to help**
- **we will be summarizing the general results – like a presidential vote – without telling anyone about any individual answers, so no one will know who told us what**
- **these summaries of the advice given to us by the producers will be shared with authorities and other stakeholders in Nairobi, but won't be sent back to the respondent;**
- **At the end of the interview, the respondents will be given a brochure summarizing the results from the project activities that have been completed so far**

They will also seek permission to ask questions about their chicken production, stressing that their identities, the name and location of the farm, and all answers will be kept confidential.

When filling the questionnaire, check a choice using an 'X', ex. ☒. If you make a mistake, do not try to erase or blot out the box that you have already checked; instead, check the box for the correct answer and circle that box to indicate it is the final correct answer, ex. ⊠

Part 1: Background information

This section provides some information about (i) the farm manager, and (ii) the chicken unit so that we have a good sense of the type of production system.

Interview ID:				Date: *dd*_____ *mm*_____ 2009			
village:				Name:		Phone No:	
Coordinates	Latitude:_____ Longitude:_____						
Age:	Gender: ☐ Male ☐ Female	Do you know how long the farm has been producing chickens/eggs? ☐ less than 5 years ☐ between 5 and 10 years ☐ over 10 years					
General farm characteristics activities, livestock kept, housing: to be able to characterize general biosecurity level, sale arrangements (to identify supply chain)							
What activities are done on this farm (tick all that apply)	☐ Broiler production		☐ Dairy				
	☐ Egg production		☐ Pigs				
	☐ Other chicken: _____		☐ Other livestock:_____				
	☐ Other poultry:_____		☐ Other (specify): _____				
What and how many poultry and other livestock do you currently keep on this farm?							
	No.		No.		No.		No.
☐ Cattle		☐ Pigs		☐ Turkeys		☐ Other:	
☐ Goats		☐ Chickens		☐ Geese		☐ Other:	
☐ Sheep		☐ Ducks		☐ Pigeons		☐ Other:	
Do you know what chicken breed you keep?	☐ Indigenous ☐ Exotic (specify if known:_____) ☐ Don't know						
Ask to see the poultry houses so that you can observe how they are built and their condition							
What materials are your poultry houses build with? (observe)	Walls: ☐ Cement block/stone ☐ Chicken wire ☐ Off-cut wood ☐ Other: ☐ Wood planks			Floor: ☐ Earthen ☐ Cement ☐ Other:	Roof: ☐ Tin ☐ Wooden shingles ☐ Other:		
How would you (the enumerator) describe the condition of the poultry houses? (provide pictures/descriptions)	☐ Very secure and clean (premises very clean and birds are fully segregated with no chance of contact with wild/other scavenging birds and feces)		☐ Somewhat (premises relatively clean with little chance of birds coming into contact with scavenging/wild birds)		☐ Poor (premises very dirty and birds can easily come into contact with wild/other scavenging birds or feces)		
What is the most frequently used method of selling broilers?	☐ slaughter here and sell dressed ☐ slaughter elsewhere and sell dressed ☐ sell live birds ☐ do not raise broilers		☐ sell to customers from farm ☐ sell to collector/trader ☐ take to market to sell ☐ sell and deliver to customers		☐ other:		
What is the most frequently used method of selling spent layers?	☐ slaughter here and sell dressed ☐ slaughter elsewhere and sell dressed ☐ sell live birds ☐ do not raise layers		☐ sell to customers from farm ☐ sell to collector/trader ☐ take to market to sell ☐ sell and deliver to customers		☐ other:		

Part 2: Bird Flu control measures

We are interested in understanding whether producers would be able and willing to comply with actions implemented, and practices promoted, by the government to stop bird flu from breaking out or spreading. Most of the questions are presented as a range. **If available, a visual representation of the question as a scale should be used to help the respondent answer.** It is important to stress that we are not interested in what the respondent thinks it the 'correct' answer, but rather what people really do.

In the tables below, the questions are grouped by type -- those that relate to: (1) what producers currently do (practices); (2) their ability to comply with the action (capacity); and (3) reasons that influence their willingness to comply with the action (incentives). In the questionnaire, however, the order of the questions will be mixed up under each mitigation measure to keep answers to the questions as independent from one another as possible.

Most questions are asked about the producer's own practices, incentives and capacities, but for sensitive questions, we want to avoid 'politeness bias', i.e., giving you the answer they think is 'correct' or they think you want to hear, so such questions are asked about how they think other producers might behave more generally.

A. Biosecurity	Biosecurity includes all the everyday measures applied to prevent introduction of disease into a farm/premise or eliminate the its spread to any other farms/production units.

Practices: *We want to get a sense of the degree to which the producer follows the recommended practices as indicated by:*

- *how often the chickens mix with other animals, esp. wild birds*
- *whether measures are taken to lower exposure to people wearing contaminated clothing*
- *how they usually dispose of sick or dead birds*
- *how movement of feed, animal health services, birds on and off farm are controlled*
- *cleaning and disinfection of houses*
- *whether all in all out principle is used*

1. Do you ever see wild water fowls near or among your chickens?

☐ Always ☐ Often ☐ About half the time ☐ Seldom ☐ Never

2. Do other livestock or animals (dogs, rats) get close to the chickens or poultry houses?

☐ Always ☐ Often ☐ About half the time ☐ Seldom ☐ Never

3. Do workers use a footbath before entering the poultry houses

☐ Always ☐ Often ☐ About half the time ☐ Seldom ☐ Never

4. Workers put on but afterwards take off, special work clothes when working in the poultry houses.

☐ Always ☐ Often ☐ About half the time ☐ Seldom ☐ Never

5. Do you clean your poultry premises?

☐ Always ☐ Often ☐ About half the time ☐ Seldom ☐ Never

6. Do you use disinfectants after cleaning your poultry premises?

☐ Always ☐ Often ☐ About half the time ☐ Seldom ☐ Never

7. Do you ensure that vehicles bringing in supplies or collecting products use disinfection dip at the gate

☐ Always ☐ Often ☐ About half the time ☐ Seldom ☐ Never

8. If you bring in new chickens, do they stay immediately with the existing birds?

☐ Always ☐ Often ☐ About half the time ☐ Seldom ☐ Never

9. Do you use all in all out principle?

☐ Always ☐ Often ☐ About half the time ☐ Seldom ☐ Never

10. (Introductory sentence: *It is sometimes said that farmers react to disease outbreaks by selling apparently healthy chickens fearing that their chickens would die.*) To what extent do farmers in this area try to quickly sell off their chickens when they start to see sick and dying birds in their flock?

☐ Always ☐ Often ☐ About half the time ☐ Seldom ☐ Never

11. Do you throw away dead birds to damping sites or bushes?

☐ Always ☐ Often ☐ About half the time ☐ Seldom ☐ Never

Capacity: *The key types of capacity considered important for farmers to be able to adopt the recommended biosecurity practices include:*

- *access to information about the practices – which should be part of available extension and best practice messages*
- *financial resources, whether their own or via access to credit*

12. You receive information on poultry health and production through your suppliers e.g. feed manufacturers and suppliers

☐ Strongly disagree ☐ Disagree ☐ Neither agree or disagree ☐ Agree ☐ Strongly agree

13. You receive information on poultry health and production from extension workers

☐ Strongly disagree ☐ Disagree ☐ Neither agree or disagree ☐ Agree ☐ Strongly agree

14. You receive information on poultry health and production because you belong to a producer or other group

☐ Strongly disagree ☐ Disagree ☐ Neither agree or disagree ☐ Agree ☐ Strongly agree

15. You make enough money to be able to improve the housing for your poultry if you thought it was important

☐ Strongly disagree ☐ Disagree ☐ Neither agree or disagree ☐ Agree ☐ Strongly agree

16. If you thought it was important to improve the housing for your poultry, you could get credit

☐ Strongly disagree ☐ Disagree ☐ Neither agree or disagree ☐ Agree ☐ Strongly agree

17. You cannot afford the investment, or chemicals to maintain a footbath at the entrance to the poultry house(s).

☐ Strongly disagree ☐ Disagree ☐ Neither agree or disagree ☐ Agree ☐ Strongly agree

18. You cannot afford the time to maintain a footbath at the entrance to the poultry house(s).

☐ Strongly disagree ☐ Disagree ☐ Neither agree or disagree ☐ Agree ☐ Strongly agree

19. You cannot afford the time to maintain a disinfectant dip at the entrance to the farm.

☐ Strongly disagree ☐ Disagree ☐ Neither agree or disagree ☐ Agree ☐ Strongly agree

20. Maintaining special clothes for the workers to wear in the poultry houses is impractical and too expensive.

☐ Strongly disagree ☐ Disagree ☐ Neither agree or disagree ☐ Agree ☐ Strongly agree

21. It is difficult to control movement of vehicles in and out of the premises

☐ Strongly disagree ☐ Disagree ☐ Neither agree or disagree ☐ Agree ☐ Strongly agree

Incentives: *Types of incentives considered relevant include:*

- *Improving their business opportunities*
- *Improving the performance of their poultry in terms of survival rates*
- *costs (financial and time) required to adopt the best practice*
- *their own asset base (having an enclosure)* (or is this a capacity?)
- *avoiding wastage*
- *value of byproducts*
- *social capital*
- *the elites in the society always wanting to be the first to adopt good practices*

22. More of my chickens will survive if the poultry housing is kept secure from other animals.

☐ Strongly disagree ☐ Disagree ☐ Neither agree or disagree ☐ Agree ☐ Strongly agree

23. You lose fewer chickens to disease if your workers wear special clothing when in the poultry house(s).

☐ Strongly disagree ☐ Disagree ☐ Neither agree or disagree ☐ Agree ☐ Strongly agree

24. Lack of space makes it impossible for you to keep other animals separated from the chicken house(s)

☐ Strongly disagree ☐ Disagree ☐ Neither agree or disagree ☐ Agree ☐ Strongly agree

25. Throwing away dead chickens is the easiest and most sensible solution for you.

☐ Strongly disagree ☐ Disagree ☐ Neither agree or disagree ☐ Agree ☐ Strongly agree

26. You suffer significantly fewer chickens lost to disease if a footbath is maintained at the entry to the poultry house(s).

☐ Strongly disagree ☐ Disagree ☐ Neither agree or disagree ☐ Agree ☐ Strongly agree

27. You like to be among the first to adopt improved poultry production practices

☐ Strongly disagree ☐ Disagree ☐ Neither agree or disagree ☐ Agree ☐ Strongly agree

28. Your efforts to improve biosecurity (segregation; cleaning and disinfection) did not prevent the disease in the past

☐ Strongly disagree ☐ Disagree ☐ Neither agree or disagree ☐ Agree ☐ Strongly agree

29. Can you think of any other reasons why producers like you would be willing and able to make efforts to limit exposure and access to their chickens?

30. Can you think of any other reasons why producers like you would NOT be willing and able to make efforts to limit exposure and access to their chickens?

B. **Reporting**

The veterinary department expects farmers and members of the public to provide information on disease outbreaks.

Practices: *The focus here is not only on officially reporting to the DVO, but also the more general issue of sharing information about disease problems with others, who in turn might report, whether the problem is in their own flock or someone else's.*

31. If chicken or egg producers have sick/dying birds, they tell other chicken keepers

☐ Always ☐ Often ☐ About half the time ☐ Seldom ☐ Never

32. If chicken or egg producers have sick/dying birds, they tell community leaders e.g. village elder

☐ Always ☐ Often ☐ About half the time ☐ Seldom ☐ Never

33. If chicken or egg producers have sick/dying birds, they tell private animal health workers

☐ Always ☐ Often ☐ About half the time ☐ Seldom ☐ Never

34. If chicken or egg producers have sick/dying birds, they tell government animal health officials

☐ Always ☐ Often ☐ About half the time ☐ Seldom ☐ Never

35. Someone would report unusual deaths in another producer's flock

☐ Very likely ☐ Likely ☐ Neither likely or unlikely ☐ Unlikely ☐ Very unlikely

36. If several producers have unusual mortality, the veterinary service will be notified

☐ Very likely ☐ Likely ☐ Neither likely or unlikely ☐ Unlikely ☐ Very unlikely

Capacity: *Types of capacity relevant to reporting include:*

- *Access to authorities, both in terms of being aware that they should report, and then getting information to an*

authority when an outbreak occurs

- *Having time (could also be considered an incentive)*
- *Knowledge/awareness that they are expected to report and how*
- *Access to information about disease problems that might affect them*

37. It is easy to contact a government animal health worker if a number of chickens get sick or die.

☐ Strongly disagree ☐ Disagree ☐ Neither agree or disagree ☐ Agree ☐ Strongly agree

38. It is easy to contact a private animal health worker if a number of chickens get sick or die.

☐ Strongly disagree ☐ Disagree ☐ Neither agree or disagree ☐ Agree ☐ Strongly agree

39. It is easy to contact community leaders if a number of chickens get sick or die.

☐ Strongly disagree ☐ Disagree ☐ Neither agree or disagree ☐ Agree ☐ Strongly agree

40. I am too busy to take the time to find and report to a government animal health worker

☐ Strongly disagree ☐ Disagree ☐ Neither agree or disagree ☐ Agree ☐ Strongly agree

41. I don't know when it becomes necessary to report a disease in my flock

☐ Strongly disagree ☐ Disagree ☐ Neither agree or disagree ☐ Agree ☐ Strongly agree

42. I can get information on disease outbreaks within my area

☐ Strongly disagree ☐ Disagree ☐ Neither agree or disagree ☐ Agree ☐ Strongly agree

Incentives: *Reasons that might encourage or discourage reporting are considered to include:*

- *Improving their ability to protect their flock from disease, or getting help to control a problem in their own flock*
- *Social capital - protecting their neighbours' flocks, or subjecting them to culling/blocked access to market*
- *Qualifying them for public support*
- *Fear of culling or blocked access to market*
- *Lack of action on previous reports*

43. Reporting will get me help to control the disease in my flock

☐ Strongly disagree ☐ Disagree ☐ Neither agree or disagree ☐ Agree ☐ Strongly agree

44. Reporting will get me help so that the disease doesn't spread to other poultry farms or household flocks

☐ Strongly disagree ☐ Disagree ☐ Neither agree or disagree ☐ Agree ☐ Strongly agree

45. Reporting will get me access to compensation

☐ Strongly disagree ☐ Disagree ☐ Neither agree or disagree ☐ Agree ☐ Strongly agree

46. If you tell anyone about a disease outbreak in your chicken flock, you won't be able to sell your chickens.

☐ Strongly disagree ☐ Disagree ☐ Neither agree or disagree ☐ Agree ☐ Strongly agree

47. If you tell anyone about a disease outbreak in your chicken flock, veterinarians will kill all your chickens.

☐ Strongly disagree ☐ Disagree ☐ Neither agree or disagree ☐ Agree ☐ Strongly agree

48. If you tell anyone about a disease outbreak in your chicken flock, other poultry producers will be angry because they won't be able to sell their chickens or eggs, their chickens will be killed, or consumers will be scared.

☐ Strongly disagree ☐ Disagree ☐ Neither agree or disagree ☐ Agree ☐ Strongly agree

49. Can you think of any other reasons why producers like you would be willing and able to report voluntarily sickness or mortality in their flocks or those of other producers?

50. Can you think of any other reasons why producers like you would NOT be willing or able to report voluntarily sickness or mortality in their flocks or those of other producers?

C. Culling with compensation (75% of market value)	If it confirmed that an avian flu outbreak has occurred, all infected birds and those at risk will be killed by the DVS as required by law. The government will compensate those affected at 75% of the market value. Poultry products will not be compensated. Now imagine that you are a farmer in a culling zone, but there is currently no disease in your flock; yet, your chicken as well as those of others have to be killed, wastes removed and chicken premises disinfected using disinfectant (e.g. Virkon®). How would you or others react?

Practices: *These reflect behaviour that would comply, or avoid compliance with, the culling effort. Since it is hypothetical, and we want to avoid polite bias, it is better to ask the question about how other people might be expected to act.*

- *Trying to avoid culling by moving/selling/hiding/eating their chickens beforehand*
- *Accepting to participate*

51. Some producers may try to remove their chickens (healthy or sick) out of the culling zones

☐ Strongly disagree ☐ Disagree ☐ Neither agree or disagree ☐ Agree ☐ Strongly agree

52. Some producers may try to hide their healthy chickens to avoid having them killed

☐ Strongly disagree ☐ Disagree ☐ Neither agree or disagree ☐ Agree ☐ Strongly agree

53. Some producers may try to sell their chickens quickly before they are killed.

☐ Strongly disagree ☐ Disagree ☐ Neither agree or disagree ☐ Agree ☐ Strongly agree

54. Producers will accept to have their chickens killed

☐ Strongly disagree ☐ Disagree ☐ Neither agree or disagree ☐ Agree ☐ Strongly agree

55. It makes more sense to slaughter and dress my chickens and store them than wait for them to be killed

☐ Strongly disagree ☐ Disagree ☐ Neither agree or disagree ☐ Agree ☐ Strongly agree

Incentives: *The main incentive for complying with culling is to qualify for compensation, but this may not be timely enough. Also:*

- *It reduces the disease risk to their family, their flocks and those of their neighbours*
- *But it does not recognize the non-financial role that poultry plays in livelihoods*
- *The farmer could get into trouble for not comply*

56. If I don't let your chickens get killed, they may die anyways and you won't get compensated

☐ Strongly disagree ☐ Disagree ☐ Neither agree or disagree ☐ Agree ☐ Strongly agree

57. If you don't let your chickens get killed, the disease will continue to affect your flocks and those of other producers.

☐ Strongly disagree ☐ Disagree ☐ Neither agree or disagree ☐ Agree ☐ Strongly agree

58. Cooperating with culling will reduce the risk to your family and workers

☐ Strongly disagree ☐ Disagree ☐ Neither agree or disagree ☐ Agree ☐ Strongly agree

59. If you don't comply with culling, you will have problems with the authorities.

☐ Strongly disagree ☐ Disagree ☐ Neither agree or disagree ☐ Agree ☐ Strongly agree

60. You don't think that compensation will be timely.

☐ Strongly disagree ☐ Disagree ☐ Neither agree or disagree ☐ Agree ☐ Strongly agree

Capacity: *The main reason why the farmer may or may not be able to comply with culling could be related to their reliance on the chickens for income and their thin cash flow; i.e. inability to wait for compensation*

61. If you let all your chickens be killed, it will destroy your business and you won't be able to feed your family

☐ Strongly disagree ☐ Disagree ☐ Neither agree or disagree ☐ Agree ☐ Strongly agree

62. Chicken-keeping is your only possible agricultural option, so you would be unwilling to comply with culling

☐ Strongly disagree ☐ Disagree ☐ Neither agree or disagree ☐ Agree ☐ Strongly agree

63. If you let all my chickens be culled, you will have to fire your workers and it will be hard for them.

☐ Strongly disagree ☐ Disagree ☐ Neither agree or disagree ☐ Agree ☐ Strongly agree

64. You can't be without poultry income during the gap between culling and new production after restocking

☐ Strongly disagree ☐ Disagree ☐ Neither agree or disagree ☐ Agree ☐ Strongly agree

65. You can cooperate with culling because your poultry business is just a portion of your income

☐ Strongly disagree ☐ Disagree ☐ Neither agree or disagree ☐ Agree ☐ Strongly agree

66. Can you think of any other reasons why producers like you would be willing and able to cooperate with the culling of their chickens when there is a disease outbreak?

67. Can you think of any other reasons why producers like you would NOT be willing or able to cooperate with the culling of their chickens when there is a disease outbreak?

D. Movement control

If there is an outbreak of avian flu, the DVS (government) will not allow any poultry to be moved from or into any infected area or within those areas as required by law. The police will enforce the ban on movement of poultry or poultry products. Farmers will be expected to confine their birds and pets. Activities such as cock fighting will be banned.

Scenario: Now, imagine that you are in an affected area and such movement controls have been announced. How would you react? (Use for reference any types of disease outbreaks and movement controls that they may have experienced previously).

Practices: *Again, this situation is hypothetical and producers may not have experienced such a situation with other diseases, so it is best to ask about how others might be expected to react. Compliance means keeping all their poultry and poultry products on their premises and limiting access, so questions address these and whether producers might go against the movement controls to sell or bring in poultry*

68. Producers would try to sell out their chickens in the event of a disease outbreak

☐ Very likely ☐ Likely ☐ Neither likely or unlikely ☐ Unlikely ☐ Very unlikely

69. You would stop any chickens or chicken products leaving your farm when there is a disease outbreak in the area

☐ Very likely ☐ Likely ☐ Neither likely or unlikely ☐ Unlikely ☐ Very unlikely

70. You would prevent visitors and traders from accessing your poultry facilities when there is an outbreak in the area

☐ Very likely ☐ Likely ☐ Neither likely or unlikely ☐ Unlikely ☐ Very unlikely

71. Producers would avoid buying or bringing in new birds when there is a disease outbreak in the area

☐ Very likely ☐ Likely ☐ Neither likely or unlikely ☐ Unlikely ☐ Very unlikely

72. You would avoid visiting other poultry farms or households when their chickens contract a contagious disease

☐ Very likely ☐ Likely ☐ Neither likely or unlikely ☐ Unlikely ☐ Very unlikely

Incentives: *Reasons why the producer might be willing to respect movement control are considered to relate primarily to protecting their own flock from disease, and other producers' (social capital). Avoiding losses and financial gain are considered possible reasons for violating the control.*

73. You would shut up your chickens when there is a disease in the area to protect them from catching the disease

☐ Very likely ☐ Likely ☐ Neither likely or unlikely ☐ Unlikely ☐ Very unlikely

74. Producers would sell their chickens in the event of an outbreak to avoid losses due to deaths

☐ Very likely ☐ Likely ☐ Neither likely or unlikely ☐ Unlikely ☐ Very unlikely

75. You would prevent visitors from accessing your poultry premises during an outbreak in the area to protect your chickens from getting the disease

☐ Very likely ☐ Likely ☐ Neither likely or unlikely ☐ Unlikely ☐ Very unlikely

76. You wouldn't sell apparently healthy chickens from your farm when there is a disease outbreak in the area to avoid disseminating the disease to other farms

☐ Very likely ☐ Likely ☐ Neither likely or unlikely ☐ Unlikely ☐ Very unlikely

77. There would be a high demand and high prices for chickens when quarantine is imposed, so producers would try sell their chickens to get high prices, in spite of the movement controls

☐ Very likely ☐ Likely ☐ Neither likely or unlikely ☐ Unlikely ☐ Very unlikely

78. Even if you don't comply with rules and regulations on movement control, the authorities don't bother you

☐ Strongly disagree ☐ Disagree ☐ Neither agree or disagree ☐ Agree ☐ Strongly agree

Capacity: *The ability of producers to comply with movement control is seen as being dependent on:*

- *Having housing, feed, and water to be able to keep their chickens confined*
- *Having the necessary facilities and alternative income to delay the sale of chicken products until the control is lifted*

79. you could not afford to continue feeding your chickens until the quarantine is lifted.

☐ Strongly disagree ☐ Disagree ☐ Neither agree or disagree ☐ Agree ☐ Strongly agree

80. You have adequate facilities for storing chicken products so as to wait to sell when movement restrictions are lifted

☐ Strongly disagree ☐ Disagree ☐ Neither agree or disagree ☐ Agree ☐ Strongly agree

81. You can delay the sale of your chickens when movement control is imposed because you have other sources of income

☐ Strongly disagree ☐ Disagree ☐ Neither agree or disagree ☐ Agree ☐ Strongly agree

82. You cant get accurate information when movement restrictions are lifted to sell your chickens

☐ Strongly disagree ☐ Disagree ☐ Neither agree or disagree ☐ Agree ☐ Strongly agree

83. You have little interaction with government that you don't know how they would implement movement control

☐ Strongly disagree ☐ Disagree ☐ Neither agree or disagree ☐ Agree ☐ Strongly agree

84. Can you think of any other reasons why producers like you would be willing and able to comply with movement controls of poultry and poultry products when there is a disease outbreak?

85. Can you think of any other reasons why producers like you would NOT be willing and able to comply with movement controls of poultry and poultry products when there is a disease outbreak?

E. Services implementing Movement Control

If there is an outbreak of avian flu and movement controls as described above are implemented, various government offices, led by the DVS and including police, would be called upon to announce, establish, and enforce the controls. This set of questions explores the producer's perceptions of the government services to effectively implement these measures.

Practices: *Not sure these are relevant in this case*

Incentives: *Producers may not be aware of institutional mandates and incentives, but they may have perceptions and opinions about what would motivate individual staff members, especially their professionalism and remuneration*

86. The DVS would unofficially allow some movement of poultry despite the quarantine because they could be given rewards

☐ Very likely ☐ Likely ☐ Neither likely or unlikely ☐ Unlikely ☐ Very unlikely

87. The police would unofficially allow some movement of poultry despite the quarantine because they could be given rewards
☐ Very likely ☐ Likely ☐ Neither likely or unlikely ☐ Unlikely ☐ Very unlikely

88. DVS staff would do a good job stopping movement of poultry and their products because they are highly dedicated and professional.
☐ Very likely ☐ Likely ☐ Neither likely or unlikely ☐ Unlikely ☐ Very unlikely

89. The police would do a good job stopping movement of poultry and their products because they are highly dedicated and professional.
☐ Very likely ☐ Likely ☐ Neither likely or unlikely ☐ Unlikely ☐ Very unlikely

90. DVS staff would actively stop movement of poultry and their products because they earn extra allowances when they do that kind of work.
☐ Very likely ☐ Likely ☐ Neither likely or unlikely ☐ Unlikely ☐ Very unlikely

91. The police would actively stop movement of poultry and their products because they earn extra allowances when they do that kind of work.
☐ Very likely ☐ Likely ☐ Neither likely or unlikely ☐ Unlikely ☐ Very unlikely

92. DVS staff like to demonstrate their authority, so they will do a good job stopping poultry movements.
☐ Very likely ☐ Likely ☐ Neither likely or unlikely ☐ Unlikely ☐ Very unlikely

93. The police like to demonstrate their authority, so they will do a good job stopping poultry movements.
☐ Very likely ☐ Likely ☐ Neither likely or unlikely ☐ Unlikely ☐ Very unlikely

94. DVS staff would not do a good job enforcing the movement control because they can't lose their jobs, so they wouldn't work very hard.
☐ Very likely ☐ Likely ☐ Neither likely or unlikely ☐ Unlikely ☐ Very unlikely

95. The police would not do a good job enforcing the movement control because they can't lose their jobs, so they wouldn't work very hard.
☐ Very likely ☐ Likely ☐ Neither likely or unlikely ☐ Unlikely ☐ Very unlikely

Capacity: *The ability of government services to implement and enforce movement control is seen to depend on:*

- *sufficient human resources*
- *logistical resources, such as transport*
- *good inter-service coordination*
- *good rapport with producers and the general public*
- *funding*

96. The government would not have enough staff to effectively monitor movement of poultry and poultry products in a quarantine zone, especially since poultry are small and easy to hide.
☐ Very likely ☐ Likely ☐ Neither likely or unlikely ☐ Unlikely ☐ Very unlikely

97. The various government services (DVS, police, etc.) work well together.
☐ Very likely ☐ Likely ☐ Neither likely or unlikely ☐ Unlikely ☐ Very unlikely

98. The DVS don't have enough funding, so would have difficulty deploying their staff.
☐ Very likely ☐ Likely ☐ Neither likely or unlikely ☐ Unlikely ☐ Very unlikely

99. The police don't have enough funding, so would have difficulty deploying their staff.
☐ Very likely ☐ Likely ☐ Neither likely or unlikely ☐ Unlikely ☐ Very unlikely

100. The DVS have enough vehicles and equipment to monitor movement control well.
☐ Very likely ☐ Likely ☐ Neither likely or unlikely ☐ Unlikely ☐ Very unlikely

101. The police have enough vehicles and equipment to monitor movement control well.
☐ Very likely ☐ Likely ☐ Neither likely or unlikely ☐ Unlikely ☐ Very unlikely

102. People do not fully trust the DVS staff that would be involved, and so would not support those services to make sure the movement controls were respected.
☐ Very likely ☐ Likely ☐ Neither likely or unlikely ☐ Unlikely ☐ Very unlikely

103. People do not fully trust the police that would be involved, and so would not support those services to make sure the movement controls were respected.
☐ Very likely ☐ Likely ☐ Neither likely or unlikely ☐ Unlikely ☐ Very unlikely

104. Can you think of any other reasons why government workers would want or be able to do a good job in making sure that movement controls are fully enforced?

105. Can you think of any other reasons why government workers would NOT want or be able to do a good job in making sure that movement controls are fully enforced?

We want to discuss similar issues with other people who handle poultry. Can you help us identify someone who buys chickens like yours?

The last time you sold one or more chickens, who did you sell them to?

☐ Another producer/grower ☐ Rural assembler ☐ Urban Broker ☐ Retailer ☐ Consumer/Restaurant/Hotel

☐ Other:

Do you know how we could get in contact with them (if not consumer)?

Name:

Contact:

Do you know what they did with the chickens and where they were taken?

Who was the second last person you sold your chickens to if the last one is not available?

Name:

Contact:

Name:

Contact:

Who was the third last person you sold your chickens to if the second last one is not available?

Name:

Contact:

Name:

Contact:

i. How long do you think will it take to build housing for poultry (wired cage with wooden skeleton)? (days, weeks)

ii. How much money do you think will it take to build housing for poultry (wired cage with wooden skeleton)?

iii. Do you know how to contact local veterinarian? (Yes/No)

iv. How do you usually contact local veterinarian? (Phone, go to his office, go to his/her home, etc)

v. How long does it take to contact local veterinarian? (___min; ___hours)

vi. How often do you see veterinarian in the village? (once a week, once in two weeks, more frequent; less frequent)

vii. Do you know where to/whom to report to died birds?

viii. What is the cost of reporting cases to:

The local vet? Phone_____ Transport_____

Private vet Phone _____ Transport _____

ix. Will you be willing to report that you poultry is sick and dying from HPAI if government pays you right away in cash 75% of market price for healthy birds and 50% of market price for sick birds and nothing for dead birds? (Yes/No)

x. Will you be willing to report that you poultry is sick and dying from HPAI if government pays you in 3-4 days later 75% of market price for healthy birds and 50% of market price for sick birds and nothing for dead birds? (Yes/No)

xi. Will you be willing to report that you poultry is sick and dying from HPAI if government pays you in 1-2 weeks later 75% of market price for healthy birds and 50% of market price for sick birds and nothing for dead birds? (Yes/No)

Thank the respondent for his/her time and kind cooperation.

Were there interruptions during the interview? ☐ Yes ☐ No

Did the respondent cooperate? ☐ Yes ☐ No

Annex 2. Time table for the enumerator training workshop at ILRI on 28th September to 2nd October 09

Monday 28th	**Session**	**Presenter**
9.00 – 10.00	Introductions DFID Project – Overview Objectives of the Institutions and Mitigations work Objectives of the training	Tom
10.00 – 10.15	Tea/coffee Break	
10.15 – 11.15	Study design of the Institutions and Mitigation study in general Specific topics to give more details: - selection of the study sites - identification of farms - identification of interviewees - administration of the questionnaires and use of caricatures Use of GPS	Bernard
11.15 – 12.30	Poultry supply chains – VC maps from the VCA by Julius Okello	Julius
12.30 – 1.30	Lunch	
1.30 – 2.30	Dos and don'ts for good communication	Bernard
2.30- 2.45	Tea/coffee break	
2.30 – 4.30	Review of questionnaires	Bernard/Julius
Tuesday, 29th		
9.00 – 10.00	Review of questionnaires	Bernard/Julius
10.00 – 10.15	Tea/coffee Break	
10.15 – 12.30	Review of questionnaires	Bernard/Julius
12.30 – 1.30	Lunch	
1.30 – 4.30	Review of questionnaires	Bernard/Julius

Wednesday, 30th		
9.00 – 4.00	Visit to Wangige to pre-test questionnaires	Bernard/Julius
Thursday, 1st		
9.00 – 4.00	Visit to Kikuyu to pre-test questionnaires	Bernard/Julius
Friday, 2nd		
9.00 – 11.00	Final review and development of work plans	Julius

Annex 3. Sampling sites for the various enumerator teams

(a) Nairobi/Nyanza team

Province	Sampling area	Sampling sites	Number of days
Nairobi	Nairobi	Ruai	4
		Umoja	2
		Embakasi	2
		Ngara	4
		Starehe	2
Central	Kiambu	Kiambu	4
Nyanza	Kisumu	Winam West/Kibos	2
Rift Valley	Narok	Ololon`ga	2

(b) Coast/Eastern team

Province	Sampling area	Sampling sites	Number of days
Eastern	Kitui Central	Kitui	2
	Mwingi Central	Mwingi	2
	Machakos	Machakos	2
	Mwala District	Mwala	2
Coast	Tana River District		2
	Malindi	Malindi	2
	Kwale	Kwale	2

(c) Rift Valley team

Province	Sampling area	Sampling sites	Number of days
Rift Valley	West Pokot	Kapenguria	2
	Baringo	Sacho	2
	Trans-mara	Kilgoris	2
	Nakuru	Longonot	4
	Laikipia	Rumuruti	8

(d) Central team

Province	Sampling area	Sampling sites	Number of days
Central	Nyeri	Chinga	6
	Murang`a	Mathioya	6
	Maragua	Kahumbu	2
	Thika	Kamwangi	2
	Nyahururu	Kipipiri	2

Annex 4. A matrix showing the number of Likert items used to formulate Likert scales for each mitigation measure, socio-economic factor and type of respondents

	Biosecurity			Reporting			Culling & Compensation			Movement Controls		
	Pra	**Inc**	**Cap**	**Pra**	**Inc**	**Cap**	**Pra**	**Inc**	**Cap**	**Pra**	**Inc**	**Cap**
S4 producers (N)	12	12	12	12	12	12	12	12	12	12	12	12
Number of Likert item questions in scale	9	8	9	7	10	5	5	7	5	5	6	4
S3 layer producers (N)	13	13	13	13	13	13	13	13	13	13	13	13
Number of Likert item questions in scale	12	6	10	6	8	6	5	6	4	6	5	5
S3 broiler producers (N)	8	8	8	8	8	8	8	8	8	8	8	8
Number of Likert item questions in scale	12	6	10	6	8	6	5	6	4	6	5	5
Traders (N)	30	30	30	30	30	30	30	30	30	30	30	30
Number of Likert item questions in scale	12	9	6	4	9	7	5	6	5	4	6	6
Retailers (N)	28	28	28	28	28	28	28	28	28	28	28	28
Number of Likert item questions in scale	8	6	6	4	7	6	5	6	5	4	4	7
Transporters (N)	22	22	22	22	22	22	22	22	22	22	22	22
Number of Likert item questions in scale	11	8	5	4	6	7	-	-	-	4	7	7
Implementing agents (N)	29	29	29	29	29	29	29	29	29	29	29	29
Number of Likert item questions in scale	7	5	6	4	7	7	-	8	5	-	13	5