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Full Length Research Paper

A descriptive analysis of the impact of avian influenza outbreaks on the livelihoods of poultry farmers in Nigeria

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Few studies have investigated the livelihood impacts of avian influenza in Nigeria at a farm level. Most of these have emphasised on the estimation of direct cost of production losses with less attention on the indirect effects relating to farm coping strategies. Using a descriptive analysis, we improved on these studies with an attempt to understand the livelihood impacts of avian influenza through a sustainable livelihood framework and farmers' coping behaviours. The livelihood impact of avian influenza varies across regions and poultry production sectors. Results of the farm survey suggest that the severity of impact on farm income is higher among the smallholders especially in the north-east geopolitical zone. The majority of the farms surveyed lost more than 50% of their monthly poultry income at the onset of the avian influenza crisis. Most severely affected group are the smallholders, particularly in sector 4 where about 21% lost between 80 to 100% of their annual poultry income. The disease outbreak also led to a significant reduction in poultry employment across the country but this is already picking up with a lower recovery rate being observed among the smallholders in sector 4 (56%) as compared to the commercial sector 2 (103%). We found that at the onset of the crisis, poultry farmers adopted a mix of responses involving asset divestment and even temporary closure but the proportion of farmers needing to adopt each coping strategy decreased with time. The findings obtained in this study are expected to inform the design and implementation of targeted avian influenza impact reduction policies in Nigeria.

Key words: Avian influenza, asset, livelihoods, poultry income, employment and coping strategies.

INTRODUCTION

Livelihood is a concept that involves a social unit (individual, household or group) pursing economic and/or consumption goals (Marschke and Berkes, 2006). The concept has received a significant contribution in the development literature since the 1990s. Chambers and Conway in their 1992 seminar paper defined a livelihood as 'comprising the capabilities, assets (stores, resources, claims and access) and activities required for a means of living'. Assets can be referred to as the stock from which various productive activities are constructed and outcomes, such as income are derived. Therefore, when assets are lost a livelihood undergoes a process of change which can affect other components of the livelihood (Davies and Hossain, 1998). A view which is people-centred considers livelihood asset, activities and outcomes as internal aspects which are exposed to external factors-referred to as vulnerability contexts (Scoones, 1998; Chambers, 2006).

Vulnerability contexts include shocks, stresses, trends and seasonal variations (DFID, 2001). Highly pathogenic avian influenza (HPAI) or bird flu outbreaks constitute a vulnerability context that has affected livelihood assets of many poultry farmers in Nigeria, since its first outbreak in 2006 (UNDP, 2006). HPAI is a poultry disease that can potentially affect multiple farms once it has affected one. It is therefore a public hazard that affects not only the poultry producers but also the consumers, feed millers, food processors, traders, employees and institutions. Since the first outbreak of Avian Influenza in Nigeria, the

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poultry industry in the country has been affected (Obi et al., 2008). Poultry farmers are among the most affected facing problems to keep their businesses intact, especially in cases where poultry is the main source of livelihood (UNDP, 2006). The impact of HPAI outbreaks on poultry farmers' livelihoods can be segregated into direct production and income losses and indirect effects relating to farmers' coping strategies adopted subsequent to the shock. Coping behaviour is 'reactive' in motive, thus coping strategies are the unplanned short-term responses to unexpected event.

However, it may be difficult to establish the exact motive behind the adoption of a coping strategy because in some cases, a strategy can also be 'precautionary' in nature serving the dual role of meeting both immediate needs and long-term goal of minimising future risks. This aspect has led to the blurring of *ex ante* risk management with *ex post* coping with crisis (Roland-Holst et al., 2008). We consider coping strategies as the short-term *ex post* reactions to HPAI outbreaks and scares. Studies pursing the agenda of understanding the impacts of HPAI outbreaks in Nigeria have mostly been conducted at a state level (Obayelu, 2007). Further, those studies that have considered a country-wide analysis in Africa to date have utilised secondary data with an assumption that such data are representative of current situation in the country (Birol et al., 2010). Many of these authors have utilised various simulation techniques to predict the impact of HPAI outbreaks under different potential scenarios but the probability that each scenario will occur is not defined (You and Diao, 2007; Okpukupara et al., 2008). Such methods are well known for masking localised and micro-level indirect effects of livelihood shocks (Ellis, 2000). There are yet to be any study that utilised a country level primary data in disaggregating the direct livelihood impacts of HPAI outbreaks in relation to the six geo-political zones in Nigeria. Also, with the exception of a theoretical analysis of household coping behaviour by Roland-Holst et al. (2007), the investigation of how farmers coped with the shock due to HPAI outbreaks is yet to receive research attention.

The aims of this study are two folds. Firstly, to investigate the level of HPAI impact on livelihoods of poultry farmers across geo-political zones in Nigeria. Secondly, to examine the coping strategies adopted by poultry farmers in response to the shock and stress caused by HPAI outbreaks in the country. In this study, HPAI impacts on farmers' livelihoods are measured in terms of income and job losses in poultry farms across the sub-sector. Understanding the livelihood impacts of HPAI across regions within the country is expected to inform targeted intervention policies. For instance, an analysis of farmers' coping behaviour may inform impact reduction policies since how they are more likely to be predicted.

The undertaking of this study is considered relevant to intervention policies because poultry production is of paramount importance in the livelihoods of many Nigerians, not only as a source of income but also a fundamental source of animal protein and employment. The poultry sub-sector worth $250 million contributing 9 to 10% of the country's GDP (FDLPCS, 2007). Further, poultry keeping is part of life in Nigeria because it represents an entry point into business with a small start-up capital required. As a result, the industry is dominated by small-scale producers. The Federal Department of Livestock and Pest Control Services (FDLPCS, 2007) reported that Nigeria's poultry sub-sector is made up of 60% village extensive and backyard intensive poultry, 15% semi-commercial and 25% commercial. While we recognise the importance of such classification based on a bottom-up approach, the FAO's (2004) classification based on the level of biosecurity investment is adopted in this study in order to allow for comparison with other studies across developing countries. The rest of this paper proceeds as follows. The paper begins by introducing the theoretical approach leading to the development of key hypotheses based on a review of the literature on impact of avian influenza and farmers' coping behaviours. The sampling design and data utilised are subsequently described. This is followed by a presentation and discussion of the results. The paper concludes with policy implications and recommendations for HPAI livelihood impact reduction policies.

STUDY APPROACH

HPAI shock touches on various aspects of farmers' livelihoods such as loss of poultry (an asset), loss of poultry income (an outcome), increased market prices of alternative protein sources (reduced access) (Obayelu, 2007), and disruption of poultry market or stimulation of control policy (institutions). Therefore, the analysis of HPAI impact on farmers' livelihoods may be located within the sustainable livelihood approach (SLA) (Scoones, 1998). The SLA is commonly referred to as an analysis that considers how people construct their livelihoods and maintain an outcome (food security, resilience, well-being, etc) today and in the future (Ashley and Carney, 1999). SLA has been widely applied to livelihood analysis in developing countries (Ellis and Mdoe, 2003; Kadigi et al., 2007).

It is not a theory but rather a holistic way of representing the relationships among key determinants of a livelihood and the contexts under which the livelihood operates. As shown in Figure 1, the SLA is usually operationalised through a framework which shows the relationships among key livelihood elements. Although there have been several frameworks in the literature owing to the complex nature of livelihoods and heterogeneous policy objectives, this paper adopts the DFID's framework as a reference point. According to this framework (Figure 1), people utilise a combination of livelihood

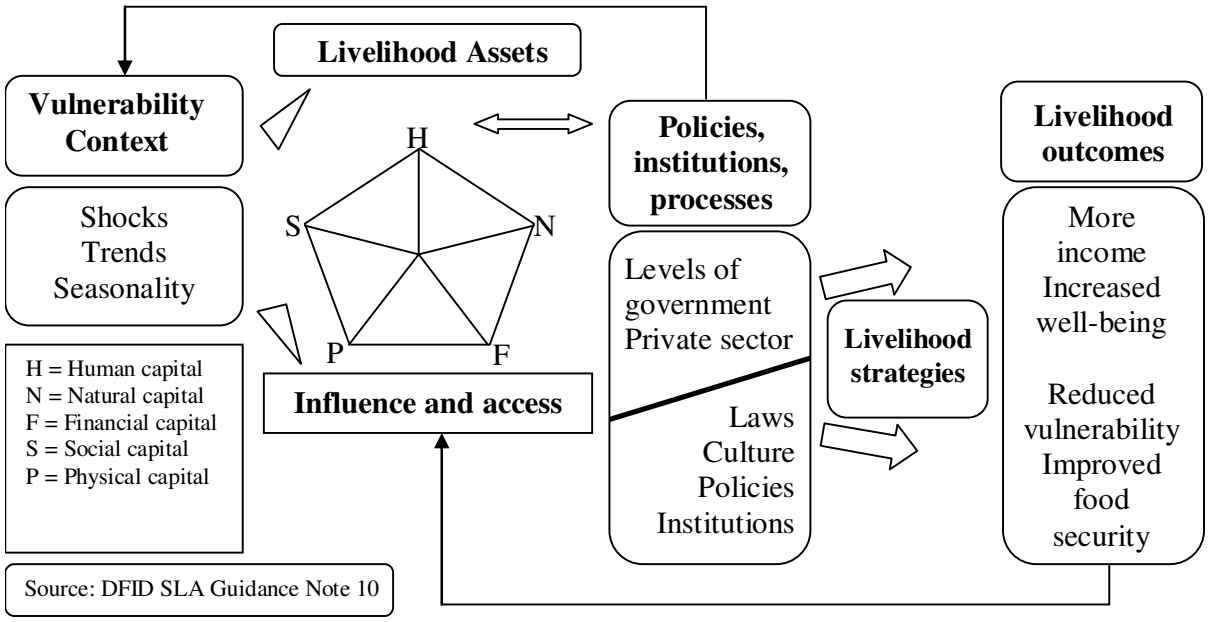

Figure 1. Sustainable livelihood framework (SLF).

assets (human, natural, financial, social and physical) to pursue a variety of livelihood strategies in order to achieve a range of livelihood outcomes. The framework is people-centred (in this case poultry farmer) and describes the inter-relationships among:

i. Farmers' assets (e.g. physical assets such as poultry and biosecurity equipment);
ii. External factors influencing their assets and access (e.g. vulnerability contexts);
iii. Farmers' behaviours emerging from the utilisation of assets (livelihood strategies);
iv. Livelihood outcomes (e.g. income, employment, resilience), and
v. Facilitating factors influencing the transformation of assets into livelihood strategies and outcomes (e.g. HPAI bird culling and compensation policies).

In this study, HPAI outbreaks (shocks) and scares (stresses) are considered as the vulnerability context affecting farmers' livelihood assets and outcomes leading to the loss of poultry and poultry income. Further, the SLA describes a livelihood as sustainable when it can cope with and recover from shocks and stresses (Scoones, 1998) indicating that the coping responses are also possible livelihood impacts of HPAI outbreaks.

As shown in Figure 1, the SLA may be problematic due to its holistic nature covering several issues at the same time. It may lead to multiple directions of causalities and could result in broader issues such as policy and institutions being covered in a snapshot (Carney et al., 1999; Yaro, 2004). Notwithstanding, the SLA is advantageous because it is actor-oriented focusing on what people have, how they access and use it, and what limits people from achieving their livelihood objectives. This enables an approach that accounts for dimensions such as coping strategies which may be hard to define or measure in a pure statistical logic. However, owing to lack of sufficient time and resources, we adapted the framework to the analysis of HPAI impacts by focusing on the asset-strategy-outcome linkage as shown in Figure 2. The figure shows that the impact of HPAI on farmers' livelihoods can be segregated into the following components:

i. The change in farmer's resource base (direct loss of birds) and emergence of control policy as a result of HPAI outbreaks;
ii. Impact of these changes on livelihood outcomes (e.g. loss of poultry income and employment); and
iii. The coping responses emerging as a result of changes in livelihood assets and outcomes.

Vulnerability context: Trend of HPAI outbreaks in Nigeria

The spread of HPAI H5N1 virus represents a significant threat to the global economy, but Africa, with its peculiarities and vulnerabilities may be expected to suffer more from its consequences due to the associated public health concerns. This explains the reason why the Nigerian society, including the Government and the civil society, reacted to the first insurgence with fear and desperation (UNDP, 2006). As at September 2008, subsequently to the first outbreak in a poultry farm in 2006, 25 out of 36 states in Nigeria (as well as the

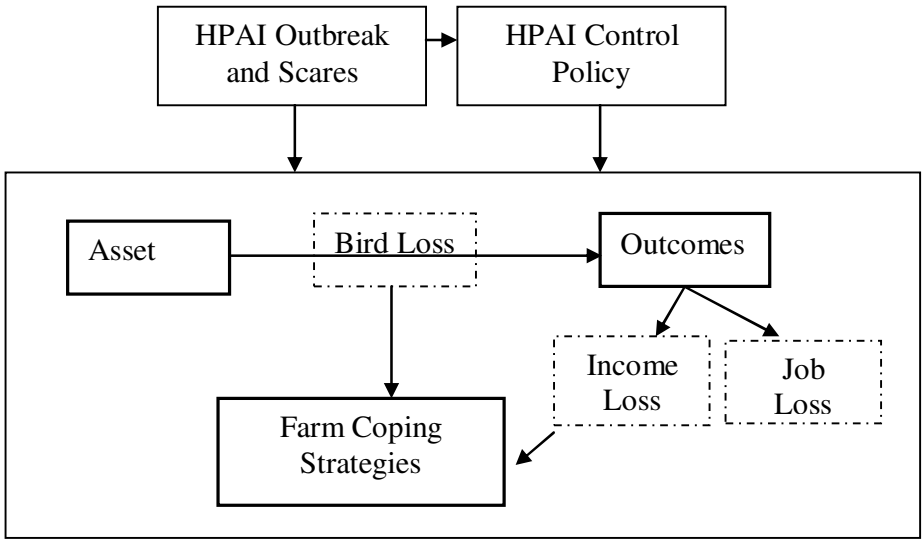

Figure 2. Analytical framework.

Federal Capital Territory-FCT, Abuja) have reported the disease in poultry, with only one confirmed human case, which occurred in Lagos State. The identification of a new HPAI strain in the city of Gombe and the 2008 outbreaks of new strains (belonging to EMA clade 3) in Kano and Katsina (never reported before in Africa) suggest that the virus is still circulating in the country (Fusaro et al., 2009).

Livelihood assets

Livelihood assets of focus in the current study are physical (poultry) and human (farm labour) capitals. HPAI directly affects the poultry farmers through losses resulting from dead birds or stamping out exercise as well as reduced sales (UNDP, 2006). Beside the direct bird losses due to the HPAI virus infection itself, the disease control policy which involves bird culling can have a significant effect on flock sizes. In 2006, birds on 668 farm holdings were culled-out and compensation paid to the poultry owners. At the onset of the outbreak there was a decline of 45% in flock size due to culling (UNDP, 2006). The number of affected poultry farmers increased to 2,735 in January 2008. As at that time, a total of about 1.3 million birds had been culled and about N623 million paid out in compensation (according to the records of the World Bank assisted avian influenza control programme, 2008). The average number of birds culled ranges from as low as 14 to as high as 14771, reflecting that all categories of poultry farmers including the smallholders were affected.

A particular factor that can cause severe economic consequence in the poultry sub-sector is the potential for bird-to-human transmission, of which some cases have been registered all over the world. However, this is extremely rare. According to the WHO statistics, only 376 people have died from H5N1 infection. This suggests that HPAI can affect other forms of assets such as the human capital due to morbidity or mortality and loss of poultry employment resulting in asset loss and redundancy. Using different scenarios of HPAI transmissions, Burns (2008) estimated that job losses resulting from the avian influenza crisis could be up to 0.2% of the global work force (or some 5 million jobs) during the time it takes the global economy to adjust.

Livelihood outcomes

A loss of poultry assets due to HPAI shock and stress can disrupt the poultry market leading to income losses for the poultry farmers, job losses for the employees and indirect effects on welfare outcomes of other stakeholders within the poultry value chain (Figure 2). The UNDP (2006) rapid appraisal shows that the official confirmation of HPAI in Nigeria caused initial panic resulting in a total boycott of poultry and poultry products. Within 2 weeks, egg and chicken sales declined by 80.5% and up to 4 months after, prices had not recovered up to 50% pre-HPAI levels. In the same study, it was reported that about 80% of the workers in affected farms and 45% of those in unaffected farms had lost their jobs at the immediate periods. A projection by You and Diao (2007) indicates that about 21% fall in chicken production and US $250 million of revenue loss could be experienced nationally if a worse case scenario of bird flu outbreak occurs in Nigeria.

At micro level, a woman keeping poultry in the Delta can lose up to US $132 poultry income (26% of annual national minimum wage) (Obi et al., 2008). According to a recent study by Okpukpara et al. (2009), poultry sales

contributes about 14% to the average poultry producing household's total annual income. These authors utilised different scenarios of HPAI risk and changes in flock size to predict that a smallholder may loss between US $25 and US $64 of its annual livestock income. Generally, the literature on economic impacts of livestock diseases has shown that the poor poultry keepers are likely to suffer the greatest impacts (FAO, 2002; Birol and Asare-Marfo, 2009). Based on this, we also hypothesise that the poor smallholders are more likely to suffer higher levels of income losses (Hypothesis 1*)*. This is likely to be the case in Nigeria where about 52% of the country's population live on less than a dollar per day (NBS, 2005). As a result, poultry smallholders are more likely to be hard hit by the waves of HPAI outbreaks which have been passing across the country since 2006.

Many of them may have little or no asset endowment upon which they could fashion out coping strategies and develop capacity to manage the risk of flock infection. The NBS (2005) poverty profile shows that poverty is more pervasive in the north with the incidence ranging from about 30% in the south-east geopolitical zone to about 60% in the north-eastern zone. In addition, Obi et al. (2008) noted that extensive poultry keeping requiring low levels of biosecurity investments is rampant in the north while commercial poultry production is common in the south. Following this, we hypothesise that the livelihood impacts of HPAI would be higher in the northern geo-political zones than in the southern zones (Hypothesis 2).

Coping strategies

Coping strategies emerge as result of changes in livelihood assets and outcomes (Figure 2). A trend in the analysis of livelihoods can be noted with earlier attention focused on the concern that livelihoods are constantly exposed to shocks and stresses, thus leading to a group of studies investigating short-term coping strategies (Watts, 1983; Corbett, 1988). Advances upon this was influenced by the work of Davies (1993) which channelled research towards the applicability of short-term coping strategies in food security monitoring and in developing indicators for early warning systems (Maxwell, 1996). A common finding from such studies across various regions and rural settings is the existence of a structure in coping behaviours (Webb, 1993; de Waal, 2004; Smuker and Wisner, 2008). It has been demonstrated that farm households make coping decisions in a sequence during a crisis relating to access to their assets and long-term livelihood security.

Although these studies have been mainly conducted on cyclical stresses (e.g. hungry season) that allow planned responses as well as those occasional stresses that triggers food insecurity and famine (e.g. drought), the reported findings provided the foundation upon which Adams et al. (1998) proposed a continuum of coping behaviours in response to events of different severities over time. They developed the continuum of coping behaviour based on the assumptions that farm households are rational evaluating the costs and consequences associated with different coping options. At the initial stage of a crisis, farm households would aim at first attempting strategies that will not deplete their stock of productive assets. Initial responses commonly reported are non-productive asset-based strategies to satisfy immediate needs (e.g. cutting household expenditure, postponing investments); and to protect future livelihood security even at a high opportunity cost (e.g. taking new loans from friends) (Phillipson et al., 2005).

If the crisis continues, the second type of responses commonly reported are productive asset-based. When farm households could not cope with the initial-stage strategies, they then begin to dispose their productive assets (e.g. livestock and equipment sale, spending of business reserves, household members looking for job, etc). Farm households that have less resilience or which could not cope with further increase in the severity of the crisis may end up selling all of their productive assets in distress. At this stage, the strategy is usually a distress migration (Pyle, 1992). In the case of poultry industry, a farmer at this stage could be found attempting to quit or close down poultry business. Following this literature, we hypothesise that the adoption of coping strategies by the affected poultry farmers would follow a discernible sequence reflecting the degree of severities as explained earlier (Hypothesis 3).

DATA AND SURVEY METHOD

Data were collected from 13 states covering the six geo-political zones in Nigeria (South-West: Lagos, Ogun and Ondo; South-South: Edo and Delta; South-East: Anambra and Enugu; North-West: Kaduna and Katsina; North-Central: Plateau and Nasarawa; North-East: Bauchi and Yobe). Among these states, Ondo has not recorded any HPAI outbreak. The state was selected in order to allow for comparison. A multistage sampling procedure is adopted in selecting a representative sample of the population of poultry farmers in all the states selected. The first stage is to choose two Local Government Areas (LGAs) from each state by using the number of poultry farms as a selection criterion. A list of all poultry farms per LGA in each state was obtained from poultry farm registers through the state HPAI desk officers. Two LGAs with the highest number of poultry farms were selected in each state. The second stage involves the selection of two communities with the highest number of poultry farms per LGA while the third stage is a random sampling of 10 poultry farms per community resulting in a total of 520 farms.

Data were collected on the livelihood impact of HPAI outbreaks and scares on poultry income, employment and coping behaviour through questionnaire surveys conducted between May and June 2009. Personal interviewing is of particular importance in this study because of the retrospective nature of some questions asked which require probing for accurate answers and consultations to farm records (Fowler, 2001). The survey covers poultry farms of various

Table 1. Interviewed farms by geo-political zone.

Geopolitical zone	No. of farms surveyed	Percentage farms (n = 459)	Average flock size	Range of flock size	Age range of farm owners	Range of year of farm establishment
South-West	91	19.83	4214	0 – 201000	25 - 67	1964 - 2009
South-South	59	12.85	4639	0 – 31200	25 - 70	1975 - 2006
South-East	78	16.99	2060	0 - 20000	20 - 68	1970 - 2008
North-West	80	17.43	3296	0 - 114000	25 - 72	1972 - 2009
North-Central	80	17.43	5203	0 - 96000	18 – 85	1954 - 2008
North-East	71	15.47	2005	0 - 21000	22 - 70	1980 - 2009
Total	459	100.00				

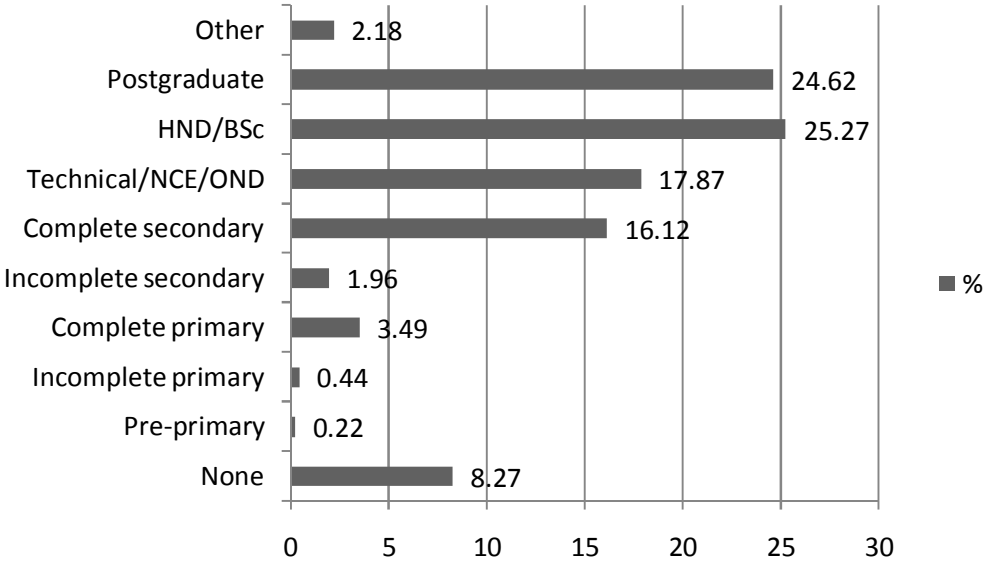

Figure 3. Percentage educational distribution of poultry farmers.

capacities and biosecurity grades; and these include all the four sectors defined based on the FAO classification (industrial, commercial, large commercial, small commercial and village/b ackyard poultry farms). The survey instrument was designed following the analytical framework (Figure 2) discussed under study approach, such that the questionnaire covered poultry asset ownership, coping strategies adopted and impacts on poultry income and employment. In addition to these, questions also touched on aspects of business recovery and biosecurity levels. Questions were designed in order to examine hypotheses discussed earlier. For example, the respondents were asked to state coping strategies adopted at various point in time subsequently to the time when they first heard of HPAI (immediate response: 3 months after, early response: 12 months after and late response: 24 months after). In the case of poultry income impact, questions were asked such as the following:

i. What is your farm's average monthly income from [income source] 3 months 'before' you first heard of bird flu?
ii. What is your farm's average monthly income from [income source] 3 months 'after' you first heard of bird flu?

Farm owners/managers were the respondents. Contrary to our sampling design, a total of 459 interviews were achieved at the end of the survey and this is the useable sample size. Each interview took an average of 49 min face-to-face with the respondent only. Although, a serious effort was put in place to elicit participation of all the farms selected but this was not possible because some farmers were reluctant to give information while a few refused to participate. This reluctance was attributed by some farmers to not wanting to remember the emotional trauma caused by the HPAI shock. Table 1 provides detail characteristics of all the farms surveyed. The majority of the farm owners are male (72.98%) and a high proportion of them have completed a university education (Figure 3). The year of establishment of surveyed farms ranges from 1954 to 2009 which reveals that there have been new entrants into the poultry industry after the turbulent periods of HPAI outbreaks.

All farms surveyed were classified into four sectors following the FAO classification of poultry production systems. This is important in order to allow for analysis of the HPAI impact by sector of production. The main variables used in the classification process are the flock size, quantity of biosecurity equipment owned and production type. The Nigeria background paper on HPAI risk reduction strategies (Obi et al., 2008) describes poultry sectors and it is from this that we adopted the criteria shown in Table 2 for classifying our samples into sectors. The majority of the farms surveyed fall under sector 4 (49.48%), followed by sector 3 (33.91%), sector 2 (15.92%) and sector 1 (0.69%) respectively.

Finally, in addition to the disaggregation by sector, data were also disaggregated by geo-political zone.

Table 2. Criteria for classifying farms into sectors.

Sector \ Criteria	Flock size	Poultry production type	Biosecurity technology (No. of disinfecting equipment owned)	Customer type
Sector 1: Industrial commercial farm	100,001 – 250,000	DOC*	High (>5)	Large commercial farmers
Sector 2: Large commercial farm	5000 – 100,000	Egg production, rearing of DOC	High/Medium (3 - 5)	Small commercial; Wholesalers
Sector 3: Small commercial farm	1000 - 4999	Egg production; broiler meat production	Medium (1 - 3)	Retailers
Sector 4: Village/Backyard poultry	1 – 999	Rearing of DOC, grower and local chicken mainly for meat	Small/None (0 - 1)	Retailers, consumers, live bird markets

*DOC: Day old chicks.

Table 3. Annual turnover of sampled businesses.

Sector	Current Annual turnover (Naira)*	% Monthly poultry income loss 3 months after first hearing of HPAI outbreak/after the farm first lost birds to HPAI (Average)
Sector 1	9,000,000 – 108,000,000	60.00
Sector 2	50,000 – 96,000,000	61.78
Sector 3	0 – 35,000,000	60.99
Sector 4	0 – 10,300,00	54.98

* At the time of survey.

RESULTS AND DISCUSSION

As shown in Figure 2, the focus of this paper is the impact of HPAI outbreaks on poultry farms' income, employment and coping strategies. Results are presented in two formats using descriptive statistics. Impacts are estimated by sector of poultry production and geo-political zones in order to understand the regional differences and variations across different groups of poultry producers.

Impact of HPAI on farm poultry income

Loss in farm poultry income is calculated as the difference between average monthly income 3 months before the farm management first heard of HPAI (or before the farm first lost birds to HPAI) and average monthly income 3 months after. Thus, percentage loss in monthly poultry income is calculated as follows:

$$\%\ \text{Monthly Poultry Income Loss} = \frac{\text{Change in Average Monthly Poultry Income 3 Months After}}{\text{Average Monthly Poultry Income 3 Months Before}} \times \frac{100}{1} \quad (1)$$

Equation 1 was computed for each of the farms surveyed and average percentage poultry income loss was calculated for each sector as shown in Table 3. As at the time of survey, the monthly income of poultry farmers across the six geopolitical zones ranges from 0 to N21,500,000. The lower limit figure indicates that many farms are yet to recover from the loss suffered due to HPAI outbreaks. There were high negative changes in the poultry monthly income three months after farms suffered direct impact of bird losses due to flock infection and culling as well as indirect impact due to fear of consuming poultry products among the consumers leading to reduced sales.

As shown in Table 3, the highest average change of about 60% is observed in each of sectors 1, 2 and 3 while sector 4 witnessed the lowest change of about 55% on average. This is however reasonable because commercial farms have larger flock size with a very high annual turnover. Therefore, a single outbreak could result in death of many birds at a go. Also, there could be a drastic change in poultry product demand by

Table 4. Percentage of total farms surveyed that suffered income loses due to HPAI by sector.

Percentage of annual poultry income lost* (Range)	Sector 1	Sector 2	Sector 3	Sector 4	Total
0-20	0.35	1.38	5.54	13.50	20.76
21-40	0.00	3.81	3.81	7.27	14.88
41-60	0.00	2.08	5.54	4.84	12.46
61-80	0.00	3.11	7.27	2.77	13.15
81-100	0.35	5.54	11.77	21.11	38.75
Total	0.69	15.92	33.91	49.48	100.00

*Over 12 months after first hearing of HPAI.

Table 5. Average percentage loss in monthly poultry income due to HPAI outbreaks by geo-political zone.

Geo-Political Zone/States	% Monthly poultry income loss 3 months after first hearing of HPAI outbreak/after the farm first lost birds to HPAI (Average)
South-West (Lagos: 58%, Ogun: 53%, Ondo: 70%)	60
South-South (Edo: 72%, Delta: 74%)	73
South-East (Anambra: 29%, Enugu: 64%)	47
North-West (Kaduna: 65%, Katsina: 38%)	52
North-Central (Plateau: 66%, Nasarawa: (-))	66
North-East (Bauchi: 87%, Yobe: 38%)	63

(-): Missing.

the food processing companies that form the main customer group for commercial farms. The current annual turnover figurespresented in Table 3 show that some farms in sectors 3 and 4 are yet to recover from their losses or planning to exit the poultry industry. Further, the percentage loss in annual poultry income was also computed for each of the poultry sectors as follows:

$$\% \text{ Annual Poultry Income Loss} = \frac{\text{Change in Total Poultry Income over 12 Months After}}{\text{Total Poultry Income over 12 Months before}} \times \frac{100}{1} \quad (2)$$

Results presented in Table 4 are consistent with the structure of poultry industry in Nigeria because the least proportion of farms affected belong to the industrial commercial sector 1 (1%) followed by 16% in the large commercial sector 2. The results suggest that there is a relationship between the level of *ex ante* biosecurity and the severity of impact. 39% of farms surveyed lost between 80 to 100% of their annual income and a majority of these farms are smallholders in sectors 3 (12%) and 4 (21%). The sector 4 farmers are the backyard and village poultry producers who have minimum or zero biosecurity technology. This explains the reason why the highest impact occurred in this sector. The backyard semi-intensive production common among the urban poor is a system in which birds are not allowed to free range within the community but within an area such as in-door open floor space or in a room within the farmer's house. Likewise, village extensive poultry production is a system where fowls usually roam or scavenge most of the day while roosting on trees or in the bush at night (UNDP, 2006).

A low level of *ex ante* biosecurity investments would increase the vulnerability of flocks to shocks and stresses. Beach et al., (2007) agricultural household model shows that the impact of bird flu outbreak depends on the farmer's *ex-ante* preventive investment and epidemiological factors such as farm-level reproductive number of the virus. Epidemiological factors that can influence HPAI reproductive number include susceptibility and the number of flocks that make contact with each other (Stegeman and Bouma, 2004; McNab and Dubé, 2007). Poultry flocks in the sector 4 are more susceptible to infections because many of the farmers could not even afford vaccines for their birds or depend solely on government's free veterinary service (Obi et al., 2008). Hence, poultry flocks in this sector may lack adequate immunity, such that a very low amount of virus is enough to infect the birds.

As shown in Table 5, average percentage poultry income loss is highest in the south-south region followed by the north-central. However, among all the states surveyed, the highest percentage poultry income loss was obtained in Bauchi state (87%) in the north-eastern zone followed by Delta (74%) and Edo (72%) states in the south-south. Perhaps this result corroborates those presented in Table 4, which suggests that the most

Table 6. Impact of HPAI on poultry employment by geo-political zones.

Geo-political zone	% Farms that laid off employees 3 months after HPAI crisis started	% Job loss	% Recovery of lost jobs
South-West	36.26	32.95	38.26
South-South	27.12	28.29	104.65
South-East	39.74	42.25	74.68
North-West	25.00	47.13	34.34
North-Central	45.00	40.96	80.89
North-East	36.62	51.74	36.52
Overall impact on poultry employment (n = 459)	35.29	41.13	62.30

severe income losses occurred among the smallholders. Existing literature has also shown that there are more smallholders in the north than in the south (Adene and Oguntade, 2006). More recently, Okpukpara et al. (2009) also showed that the percentage share of poultry income in household annual income is highest in the north-east. Meanwhile, in the south-west the average percentage poultry income loss in Ondo state (70%) which has not recorded any outbreak is higher than those of other affected states in the region (Lagos: 58%, Ogun: 53%).

This might suggest that the threat of HPAI outbreak is as important as actual outbreaks.

A cross-country study conducted by Birol et al. (2010) in four African countries (Nigeria, Ghana, Ethiopia and Sudan) also suggests that the effect of HPAI scares on poultry demands can be very significant. However, since the results are based on farm averages only it is difficult to associate the observed differences strictly to the HPAI shock because other factors such as the farm's *ex ante* diversification level, state-level disease control interventions, media, etc which we have not controlled for could have also contributed to the differences. Overall, the results presented in Tables 3, 4 and 5 probably suggest that the severity of impact on farm income may be higher among the smallholders especially in the north-east geopolitical zone.

Impact of HPAI on poultry employment

Poultry job loss is calculated as the difference between farm's total number of employees one month before the farm management first heard of HPAI (or when farm first lost birds to HPAI/culling) and the total number of employees 3 months after:

$$\% \text{ Job Loss} = \frac{\text{Total No. of Employees 1 Month Before} - \text{Total No. of Employees 3 Month After}}{\text{Total No. of Employees 1 Month Before}} \times \frac{100}{1} \quad (3)$$

Solving Equation 3 reveals that the impact of HPAI on poultry employment was widespread. As shown in Table 6, about 35% of farmers surveyed laid off their employees 3 months after HPAI crisis started in the country leading to about 41% of total poultry jobs being lost. This result is similar to the finding of UNDP's (2006) rapid appraisal where it was reported that farmers were forced to retrench workers to the tune of 46%. However, this impact of HPAI on poultry employment varies across the six geo-political zones. 45% of all farms surveyed in the north-central downsized their staff strength. Similarly to our findings on poultry income impact, the highest share of regional jobs was lost in the north-east followed by north-west. In the south, our results reveal that about 42% of all jobs in the south-east were lost to HPAI crisis. The lowest job loss occurred in the south-south (Table 6).

In terms of poultry production sectors, job loss was also highest in sector 4 followed by the large commercial sector 2 (Table 7). One explanation for this statistics may be that smallholders have limited asset endowments and thus probably have less capacity to cope and maintain their staff strength. Further, since the majority of them have a very small number of employees (0 – 20) *ex ante*,

it may be easier to lay them off as a coping strategy to survive the HPAI crisis. In contrast, the smallest percentage share of total job loss (17%) occurred in the industrial commercial sector 1 which involves a sophisticated system of production that requires specialised skills. Among such farmers, laying off employees with specialist skills and experience may be difficult because of the associated long term investments in human capital. Besides, the number of industrial commercial farms in Nigeria is very small; thus making their share of total loss smaller.

Even though the percentage share of the total job lost obtainable in sector 1 is the smallest, the HPAI impact on

Table 7. Impact of HPAI on poultry employment by sector.

Sector	% Farms that laid off employees 3 months after HPAI crisis started	% Job loss	% Recovery of lost jobs
Sector 1	0.44	17.20	11.54
Sector 2	11.76	26.32	103.02
Sector 3	9.15	21.03	63.52
Sector 4	13.94	35.45	56.34

poultry employment is different at farm levels. While many farmers in sectors 3 and 4 were found to have laid off 1 to 8 workers, one industrial commercial farm laid off up to 130 employees 3 months after the bird flu crisis began. These impacts would have no doubt resulted in a severe shock for the retrenched workers and their families. It was further investigated whether or not the farms have reemployed subsequently to the crisis period. The recovery of jobs lost is calculated as follows:

$$\% \text{ Job Loss being recovered} = \frac{\text{Change in the remaining number of jobs}}{\text{Total No. of jobs lost}} \times \frac{100}{1} \quad (4)$$

Change in the remaining jobs is the difference between number of employees, 3 months after and the current number of employees as at the time of survey. As time passed by, poultry farmers have benefited from various programmes (such as training on biosecurity, compensation scheme, etc) put in place by the federal government and international organisations. These institutional interventions might have assisted some farmers in recovery as a lot of improvement can be observed in poultry employment.

As shown in Table 6, all jobs lost in the south-south have been recovered (105%) probably because this is the zone with the least regional job losses. In the north-east, in which Bauchi state recorded the highest average monthly poultry income loss the recovery rate is low (37%) which probably reflect the fact that many smallholders are yet to recover as revealed by zero current annual turnover of some farms in sectors 3 and 4 (Table 3). As shown in Table 7, the percentage of jobs recovered in sectors 3 and 4 is lower than that in sector 2. The table shows that all jobs lost in sector 2 have been recovered (103%). One explanation for this statistics is probably the fact that commercial farmers might have a better access to financial capital for restocking (e.g. bank loans, insurance, etc) than smallholders. However, this is not consistent since the lowest average recovery rate is observed for sector 1 where the highest number of jobs was lost per farm as earlier explained.

Coping responses of poultry farmers in Nigeria

Coping strategies adopted by farmers in responding to HPAI outbreaks and scares are presented in Table 8. Following the literature reviewed under study approach (Adams et al., 1998), we investigate the observable sequence in farms' coping behaviour, that is the pattern in their responses over time and how this varies from north to the south.

Sequence in coping behaviour

Poultry farms in Nigeria display a wide range of coping behaviours that provides some directions in the manner in which HPAI impacted businesses. The number of coping strategies adopted by each poultry farm can be assumed to also reflect the severity of impact suffered. Among all states sampled, poultry farmers in Bauchi state adopted the highest number of coping strategies (8.3) on average followed by Edo state (5.6). These states fall in the geo-political zones where the highest average monthly poultry income loss was obtained as explained under impact of HPAI on farm poultry income. This result may suggest that the more a farm has to cope, the higher the impact experienced. In general, the average number of coping strategies adopted per farm is higher for states where outbreaks have been reported compared to Ondo state where no outbreak has been recorded (2.2). As shown in Table 8, the most common coping strategies adopted by more than one third of the poultry farms 3 months after the HPAI crisis started in Nigeria are: cancellation or postponement of investment (42%), cutting back household spending or expenditure (38%), and cancellation or postponement of plans to expand poultry business (31%). Other immediate coping responses adopted by farmers include increase in poultry marketing or advertising (21%), etc. Our results indicate that poultry farmers first resorted to coping decisions that will not deplete their resource-base. This is why internally-based coping options that revolve around farm household decisions such as cutting down household expenditure, form most of the immediate responses of poultry businesses surveyed.

Table 8. Percentage of total farms surveyed adopting coping strategies.

Coping strategies adopted	Immediate response	Early response	Late response
	3 months after the farm first lost birds or after first hearing about outbreak % farms (n = 459)	12 months after the farm first lost birds or after first hearing about outbreak % farms (n = 459)	24 months after the farm first lost birds or after first hearing about outbreak % farms (n = 459)
Farm owner and employees taking smaller wage	17.65	10.68	6.32
Cancelled or postponed investment	42.27	23.09	11.98
Reduce staff working hours	10.89	5.45	2.83
Increase staff working hours	4.79	3.92	6.32
Increase marketing/advertising	20.92	9.59	8.93
Decrease marketing/advertising	8.28	6.75	3.27
Cut back household spending/expenditure	38.13	18.74	11.33
Spend business reserves	32.90	13.73	6.54
Cancel or postpone plans to expand business	30.50	17.21	12.42
Renegotiate existing loans	5.45	3.49	1.96
Spend personal savings	33.33	15.69	5.88
Take out new loan	2.61	2.83	1.74
Layoffs/redundancies	11.11	5.67	3.27
Not taking on seasonal/causal staff	5.45	3.92	1.74
Change business strategy	13.51	10.68	7.84
Household member looking for job	4.58	3.05	1.74
Temporary closure	17.21	9.15	5.01
Ask staff to take holiday	9.37	4.58	2.40
Attempt to sell off poultry business	3.93	1.96	0.87
Depended on the assistance from poultry association	1.09	0.87	0.65
Depended on the assistance from non-poultry association	1.09	0.44	0.65
Seek assistance from friends/family	8.93	5.67	3.92

According to Phillipson et al. (2004), it is expected that households would resort to coping strategies based on asset disinvestment as the crisis intensifies. Consistently, the number of farms adopting coping options that involve asset disinvestment 3 months after the bird flu crisis started in Nigeria is quite high (Table 8). Such responses include spending of personal savings (33%), spending of business reserves (33%), staff layoffs/ redundancies (11%), and household members looking for jobs (5%). Again, the literature suggests that when farms have disposed of their productive assets in distress they are more likely to be forced to seek external support (Adams et al., 1998). Late coping responses such as seeking help from family or poultry association, temporary closure, and change of business strategy are expected to be dominant coping choices at the later stage of the crisis. However, Table 8 shows that the majority of farmers took these late coping options at the onset of the HPAI crisis and the number of farmers needing to adopt various coping strategies decreases with time. About one fifth of the farmers surveyed had even reached a stage of temporary closure at the onset of HPAI outbreak, which is contrary to expectation.

The lesson to be drawn from this finding is that HPAI outbreaks and scares would have resulted in much serious impacts on poultry farmers, if

there had been no interventions from the government and international organisations. Few months after February 2006 when HPAI outbreak was first recorded in Kaduna, the federal government was yet to devise sound approaches for controlling HPAI and minimising its impacts on poultry farmers. Most of the coping strategies adopted by a majority of the farmers during this period were based on asset disinvestment. Meanwhile, as time passed by there were improvements in institutional response to the crisis via various mechanisms. This might have been one of the reasons why a significant reduction in the percentage of farmers adopting each coping strategy could be observed overtime. For instance, 24 months after HPAI outbreak began, the percentage of farmers attempting to sell off poultry business decreased from 3.93 to 0.87.

Conclusion

An understanding of the livelihood impacts of HPAI on poultry farmers across regions may be useful in informing targeted impact reduction policies. This paper aimed to examine the impact of HPAI outbreaks and scares on farmers' livelihoods in Nigeria by focusing on their poultry income, farm employment and coping strategies. The study adopted an analytical framework adapted from a sustainable livelihood approach in order to shed light onto the impact of asset shock created by HPAI outbreaks on farmers' livelihood outcomes. Based on the literature reviewed, we investigated three hypotheses using farm level descriptive statistics generated through a survey of poultry farms across the six geo-political zones in Nigeria.

Firstly, we examined whether or not the poultry smallholders suffered higher levels of income losses. The result show that the majority of the farmers surveyed lost more than 50% of their monthly poultry income at the onset of the avian influenza crisis and this is mostly in the poultry production sectors 2 and 4.

However, the most severely affected group of poultry farmers are the smallholders, particularly in sector 4 where about 21% of them lost between 80 to 100% of their annual poultry income. The disease outbreak also led to a significant reduction in poultry employment across the country but this is already picking up. Meanwhile, the employment recovery rate among the smallholders (sector 4: 56%) is lower compared to that for the commercial sector 2 (103%). This result probably suggests that the smallholders have lower *ex ante* asset endowments from which fall back mechanisms could be derived to develop coping mechanisms for bouncing back.

Secondly, we investigated the hypothesis that the livelihood impact of HPAI is likely to be higher in the northern Nigeria where there are more smallholders. The descriptive analysis shows that the average poultry income loss is highest in Bauchi state (87%) in the north-east geo-political zone. Similarly, the average recovery rate for lost jobs is lower in the north-east (37%) as compared to the south-south where farms on average have fully recovered all poultry employments lost to the tune of 105%.

Finally, the paper assessed the sequence in the adoption of coping strategies among the affected poultry farmers. We found that mixed coping responses were adopted by poultry farmers at the onset of HPAI outbreaks in Nigeria, which is contrary to our hypothesis that the adoption of asset divestment and farm closure should occur at later stages of the crisis. However, the lesson drawn from this result is that as the level of institutional response to the HPAI outbreaks increases in the country, the livelihood impact of the crisis continues to decrease over time. This is evident since the number of farmers needing to adopt each coping strategy decreases with time.

Even though these findings are from a descriptive analysis, they perhaps suggest that in the event of future disease outbreaks, poultry farmers are more likely to respond with desperation in the absence of effective intervention mechanisms. Likewise, in view of resource constraints, the identification of regional and sectoral differences in livelihood impacts is expected to inform the design of targeted HPAI impact reduction policies in Nigeria. Meanwhile, our findings can only be treated as an explorative basis for further investigation, since our results are simply based on descriptive statistics. Nevertheless, there are some convergences in findings obtained in this paper and those reported in other country-level econometric analyses (Okpukpara et al., 2009; Birol et al., 2010), which also show that the impact of HPAI outbreaks and scares are higher among the smallholders and in Northern Nigeria.

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