NIGERIAN VETERINARY JOURNAL
ISSN 0331-3026
Nig. Vet. J., March 2017 Vol 38 (1): 13-25.
ORIGINAL ARTICLE

Newcastle Disease and Biosecurity Practices in Live Bird Markets in Benue State, Nigeria

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SUMMARY

A study on the assessment of biosecurity situation and practices in live bird markets (LBMs) against Newcastle disease (ND) in Benue State was conducted from May to August 2013. The biosecurity practice was assessed using structured questionnaires administered to fowl sellers in LBMs, biosecurity checklists as well as observations. A total of 28 respondents from nine selected LBMs were interviewed on different factors that contribute to biosecurity situation and practices. Simple descriptive statistics was used to summarize and present results. The result showed that 53.8% operated their LBMs daily while 46.2% operated weekly. Most (78.6%) of the LBMs were not fenced. In 67.9% (19/28) of the markets, birds were kept in cages made of wood, 21.1% (4/19) used baskets and 32.1% (14/19) kept birds on the ground. Other species of birds 82.1% (23/28) were sold in most of the LBMs and 78.6% (22/28) reported selling other animals such as goats 54.6% (12/22). Fowls sellers used poultry manure on crops farms (60.7%). Majority of the fowl sellers, 96.4% (27/28) do not wear coverall or any protective clothing when handling poultry. Most of the fowl sellers 81.5% (22/27) reported that LBMs were not usually cleaned and disinfected. Only 35.7 % (10/26) of the markets assessed had a processing area. The study concludes that poor sanitation was the highest biosecurity risk (70.0%) in the LBMs. There is need for regular disease surveillance and development of strategies to improve biosecurity in the LBMs.

Key words: Biosecurity, Live bird markets, Newcastle disease, Benue State.

INTRODUCTION

Newcastle disease is a highly contagious viral disease that attacks many species of domestic and wild birds caused by avian paramyxovirus serotype 1 (APMV-1) (Al-Garib *et al.*, 2003; Alexander, 2003). Newcastle disease has been established in at least 241 species of birds representing 27 of the 50 orders of birds (Kaleta and Baldauf, 1988). It is believed that all bird species are most likely at risk to be infected with Newcastle disease virus (NDV) but the effects of the disease vary with different species (Caupa, 2009). Most species of birds including chickens, pheasants, pigeons,

quails and guinea fowls are highly susceptible to virulent APMV-1. Waterfowls such as ducks and geese may be infected but show few or no clinical signs even to the strains virulent to chickens (Liu *et al.,* 2007). The transmission of NDV occurs through newly introduced birds, selling or giving away sick birds, exposure to fecal and other excretions from infected birds and contact with contaminated feed, water, equipment and clothing (Tu *et al.*, 1988).

The economic losses in ND are due to high mortality and morbidity, decreased production of eggs from layer and production of eggs of low quality from breeder flocks (Aamir *et al.,* 2014). Also the cost associated with the control measures which may include stamping-out, vaccination and constant or repeated sero-monitoring (Leslie, 2000). The treatment cost along with extra management of poultry flocks during course of the disease also enhances the economic losses due to ND (Aamir *et al.,* 2014). Biosecurity refers to the implementation of policies and practices that prevent the introduction and spread of disease in a farm or between farms (USAID, 2009). Biosecurity has three major components: Isolation of premises and poultry from sources of infection, controlling traffic flow in and out of susceptible areas to limit exposure and sanitation which refers to the cleaning and disinfection of equipment, housing, vehicles, protective clothing for poultry workers (USAID, 2009). Inadequate biosecurity is conducive for spread of ND (Okwor and Eze, 2010). The ND can be prevented through strict biosecurity and restricting movements of infected birds.

Live bird markets are essential for marketing poultry in many developing countries, and they are a preferred place for many people to purchase birds for consumption throughout the world (Cardona *et al.*, 2009). The current live poultry marketing system represents a significant and potential hazard to both buyers and sellers, yet implementation of biosecurity and hygienic practices in such a system is generally difficult (FAO, 2007). In Nigeria, about 90% of poultry marketing is done by sales of live birds with less than 2% comprising processed or frozen chicken (Muhammed, 2008). Live bird markets can be high-risk areas for disease transmission due to high concentration and interaction of a wide variety of birds coming from different sources (Choi *et al.*, 2005). Contamination of LBMs with viruses is usually associated with movement of live birds from outbreak areas and attempt by poultry farmers to sell infected birds in an effort to reduce economic loss (Nguyen, 1992). In Benue State, there are favorable factors that could result to ND outbreak such as the presence of the river Benue which can serve as resting points for migratory wild birds which have been reported as reservoirs of ND (Yuan *et al.*, 2013). Also, trade in live birds and poultry products with most states across Nigeria. Large volume of poultry and poultry by products pass through the state thus serving as transit point for live birds moving from the north to the south east and south west of the country and vice versa. Though most village poultry originate from Northern Nigeria, they are marketed mainly in the South (Muhammed, 2008). The movement of poultry and poultry products is one of rural producer to urban consumer which from biosecurity point of view is very important, since it favors spread of diseases all over the country (Dessie and Ogle, 2001). At these LBMs, multiple species of birds are kept together and in confined spaces. It is quite common that ducks are kept together with local chickens, layers or broilers and these increase the chances of spread of ND viruses (Musa *et al.*, 2009; Mai *et al.*, 2004).

Live bird markets may also be a source of infection to poultry farms if the farmers take back to the farm unsold poultry which would have mixed with others in the markets. Poultry from commercial farms and village poultry may mix together in these

markets. Traders, intermediaries and service providers also visit LBMs and may easily move contaminated materials from these markets to poultry farms. It is estimated that over 2 million live birds are sold daily in LBMs across Nigeria which highlights the position of LBMs in the control of avian diseases especially ND (Muhammed, 2008). Thus, it has become imperative to give priority to poultry health management through the implementation of sound biosecurity measures in LBMs. This will go a long way in minimizing the problem of disease outbreak and spread in the poultry industry and maintain the consumers' confidence in poultry products. Therefore, it is essential to assess the risk and identify factors that can potentially influence introduction and spread of NDV along the production-marketing chain. This study was therefore designed to access the biosecurity practices of fowl sellers in LBMs in Benue State with specific relevance to the risk of outbreaks of ND in the study area.

MATERIALS AND METHODS

Study Area

The study was conducted in Benue State located in the north central zone of Nigeria. The state occupies a land mass of 32, 518 sq km and lies within the lower river Benue in the middle belt region of Nigeria. Its geographic coordinates are Longitude 7° 47' and 10° 0' East, Latitude 6° 25' and 8° 8' North of the Equator. Most of the people in the State are farmers while the inhabitants of the riverine areas engage in fishing as their primary occupation. Benue State has an estimated total poultry population of 6, 735, 041 made up of 90% village poultry (FDLP, 2006). Nine LBMs were selected purposively from six local government areas (LGAs) (Gboko, Katsina Ala, Kwande, Makurdi, Oju Otukpo) based on their consent and readiness to participate in the study.

Assessment of Biosecurity in Live Bird Markets

The survey assessed the status of biosecurity measures and practices grouped into three categories to include: isolation and traffic control, sanitation and management practices. The assessment was made in relation to the potential risk each of the factors could pose in the introduction and/or spread of ND viruses in LBMs during disease outbreak. The assessment was undertaken through the use of structured questionnaire administered via interviews to fowl sellers. The questionnaire gathered information about fowl sellers attitude and practices on biosecurity, market type, where birds are kept, species of birds sold in the LBMs, methods of disposal of manure, sick or dead birds and knowledge of ND. A biosecurity checklist was used to assess the biosecurity features present in the LBMs such as fence, entry and exit doors, processing areas, type of cages, use of personal protective equipments (PPE) and the biosecurity risk level was estimated.

Criteria used for Scoring Biosecurity Risk Levels

Scoring of risk levels was done using a numerical system of 0-3 (Adopted from USAID, 2009) manual for Stop AI in Nigeria for poultry farms and LBMs) (Table 1).

Table 1: Criteria used for Scoring Biosecurity Risk Levels in live bird markets

Biosecurity risk levels	Biosecurity practices/features
0 = No risk	None present or no contact observed
1 = Low risk	Minimal present or no contact observed
2 = Moderate risk	Some present and or minimal contact observed
3 = highest risk	Significant amount present or significant contact observed

Data Analysis

The data obtained from the questionnaire and checklists were entered into Excel and analysis was done using Statistical Package for Social Sciences version 17.0 program (SPSS Inc. Chicago, IL, USA). Descriptive statistics was used to calculate the frequency, percentages and chi square values by cross tabulations. Values of $p<0.05$ were taken as significant.

RESULTS

Most of the LBMs 78.6% (22/28) assessed were not fenced and 93.7% (15/16) had no exit or entry doors. About 69.2% (18/26) of the LBMs were located less than 100 m from residential areas. Wooden cages were used by 67.9% (19/28) of sellers to keep their birds, 21.1% (4/19) used baskets and 32.1% (9/28) kept birds on the ground ($p = 0.002$). About 82.1% (23/28) and 78.6% (22/28) of sellers reported that ducks and other animals (cattle, goats, Pigs) were sold in the LBMs and 63% (17/27) reported presence of stray dogs. Sellers 42.3% (11/26) also reported the presence of wild birds with 9.1% (1/11) reporting hawks, 45.5% (5/11) reporting pigeons and vultures respectively (Table II). Staking of cages on each other was observed in 52.6% (10/19) with 72.2% (13/18) reporting that cages were contaminated with faeces. Overcrowding of cages was reported by 38.9% (7/18) of the sellers. All sellers separated birds by age 100% (28/28), 42.9% (12/28) and 64.3% (18/28) separated birds by breed and species respectively while 46.4% (13/28) separated poultry by type. Sellers reported the presence of rodents in LBMs 60.7% (17/28) with 20% (2/10) controlling them with traps or rodenticides while 60% (6/10) of sellers reported no rodent control. Results showed that 48.1% (13/27) of sellers would eat sick birds while 18.5% (5/27) would sell them. About 14.3% (4/28) of sellers would bury dead poultry while 85.7% (24/28) would throw away dead birds. The use of poultry manure on farm was reported by 60.7% (17/28) of fowl sellers while 10.7% (3/28) and 28.6% (8/28) would sell and throw away their manure respectively. The sale of cooked food around poultry sheds was reported by 81.5% (22/27) (Table III). Sellers do not wear overall when handling poultry 96.4% (27/28) and none 100% (28/28) wore PPE such as boots, face mask, gloves or goggle. Some sellers do not wash their hands 39.3% (11/28) after handling poultry and 81.5% (22/27) reported that LBM were not usually cleaned and disinfected. Transportation of bird to LBMs using lorry, motor bike, bicycle or foot was utilized by 39.3% (11/28) of sellers while 35.7% (10/28) preferred to use bus. Fowl sellers reported

Table II: Isolation and traffic control biosecurity risks and risk levels in live bird markets in Benue State, Nigeria

Isolation and traffic control	Response to biosecurity risk (%)	Risk level
Live bird market not fenced	78.6	3
No entry/exit door	93.7	3
Birds kept in wooden cages	67.9	3
Birds kept in baskets	21.1	3
Birds on the ground	32.1	3
Presence of stray dog	63.0	2
Presence of wild birds	42.3	2
Other livestock sold in live poultry market	78.6	3
Live bird market located < 100 m to residential areas	69.2	3
Overall average	60.7	2.8

Risk level: 0 = No risk; 1= Low risk; 2 = Moderate risk; 3 = Highest risk level

Table III: Biosecurity risk associated with management practices and risk level in live bird markets in Benue State, Nigeria

Management practices	Response to biosecurity risk (%)	Risk level
Birds not separated by breed	42.9	3
Birds not separated by species	64.3	3
Birds not separated by type	46.4	2
Overcrowding of birds in cages	38.9	3
Sellers stacked cages on each other	52.6	3
No processing area in LBMs	61.5	3
Sale of food in LBMs	81.5	3
Sale of sick birds	18.5	3
No rodent control program	60.0	2
Use of poultry manure on farm	60.7	2
Sellers do not report ND outbreak	53.3	3
Overall average	52.8%	2.7

Risk level: 0 = No risk; 1= Low risk; 2 = Moderate risk; 3 = Highest risk level

Table IV: Unsanitary biosecurity practices and risk level in live bird markets in Benue State, Nigeria

Sanitation practices	Response to biosecurity risk (%)	Risk level
Live bird market not clean and disinfected	81.5	3
Cages contaminated with faeces	72.2	3
Processing area not clean	60.0	3
Vehicles transporting poultry to market not clean and disinfected	74.1	3
Seller do not wear PPE	100	3
Sellers do not wash hands after handling poultry	39.3	3
Improper disposal of dead birds	85.7	3
Improper disposal of poultry manure	28.6	2
Presence of flies in live poultry market	88.9	3
Overall average	70.0%	2.9

Risk level: 0 = No risk; 1= Low risk; 2 = Moderate risk; 3 = Highest risk level
PPE = Personal protective equipment

that vehicles used for transporting birds to LBMs were not usually cleaned nor disinfected 74.1% (20/28). There was presence of flies in most 88.9% (24/27) of the LBMs. Some (61.5%) of the LBMs surveyed did not have processing area with some of the sellers 60% describing their processing area as dirty (Table IV). Water was sourced from well/stream by 65.4% (17/26) of fowl sellers with 19.2% (5/26) use tap water sold by vendors. About 66.7% (6/9) sellers report that run-off from processing areas goes to nearby drainages with 33.3% (3/9) emptying into river Benue. Knowledge of poultry disease was high 76.9% (20/26) among the fowl sellers with their knowledge of ND ranking highest 95.2% (20/26). Majority 78.3% (18/23) of the fowl sellers reported that of all the poultry diseases they know, ND comes first in terms of frequency of outbreak and high mortality. On reporting of ND outbreak by

Table V: Biosecurity practices of fowl sellers in daily and weekly live bird markets in Benue State, Nigeria

Biosecurity practice	p-value	Daily LBM % response	Risk level	Weekly LBM % response	Risk level
LBM not fenced		57.1	3	100	3
Birds not in cages	0.003	0	0	58.3	3
Birds on the ground		0	0	72.7	3
Birds not separated by breed	0.005	21.4	2	91.7	3
Birds not separated by species	0.01	14.3	2	50	3
Birds not separated by type	0.001	14.3	2	91.7	3
Rodents in LBM		85.7	3	33.3	2
Ducks sold in LBM		64.3	3	100	3
Stray dogs/cats in LBM	0.036	42.9	3	90.9	3
Other animals in LBM		57.1	3	100	3
No processing area in LBM	0.005	35.7	3	91.7	3
No washing of hands		42.9	3	83.3	3
Cooked food sold in LBM		64.3	3	100	3
Overall		38.5	2.3	81.8	2.9

Key: LBM = Live bird market; p-value= level of significance

fowl sellers to appropriate authority 57.1% (16/28) will report while 53.3% (8/15) stated they will not report ND outbreak because the authority had not brought any intervention to their LBMs. Record of sales by sellers was high 57.1% (16/28) during festive periods such as Christmas, New year and Easter celebration and low during new yam festival 6% (1/28). The study revealed that 53.8% (14/26) of the LBMs sellers surveyed operated from daily market while 46.2% (12/26) operated from weekly LBMs. About 35.7% (10/28) of the fowl sellers were located outside the main market while 64.3% (18/28) operated in LBMs located within the main market. All LBMs in Katsina Ala, Kwande, and Oju LGAs were located within the main market. In the weekly LBMs 75% (9/12) of the birds were housed in baskets while in the daily LBMs no basket was used (p=0.003). About 35.7% (5/14) of the daily LBMs and 91.7% (11/12) of the weekly LBMs had no processing area (Table V).

DISCUSSION

The study revealed that LBMs in Benue State operate daily and weekly. Most of the daily LBMs were located in the major towns like Makurdi, Gboko and Otukpo LGAs while weekly LBMs were located in smaller towns and villages in Kwande, Katsina Ala and Oju LGAs. This is similar to reports of Pagani *et al.*, 2008; Musa *et al.*, 2009. The study also revealed that in the rural areas most of the LBMs were located within the main market unlike in the urban areas where there might be more than one market with some of the LBMs located outside the main market for easy accessibility of customers. Almost all surveyed markets were not fenced off from the rest of the general merchandise markets. The markets also lacked specific entrance and exit doors contrary to general biosecurity recommendations (FAO/OIE/WHO, 2005). Isolation anomalies of this category easily expose the general public to risk of infection with avian influenza (AI) viruses and other infectious avian diseases (Bulaga *et al.*, 2003). The absence of fence would render enforcement of traffic control impractical or impossible thereby increasing the ease of disease spread by humans, animals and formites (Warwick *et al.*, 2012). The location of most LBMs near residential areas

as shown by this study will increase the likelihood of household local poultry scavenging in to LBMs and coming in contact with secretions and excretions contaminated with NDV (Rahman *et al.*, 2014; Salihu *et al.*, 2012). This will increase the risk of infection and spread among the poultry at homes which could result in an outbreak. Results of the study showed that wooden cages and baskets were mostly used in the LBMs to hold birds. Baskets were used more in weekly markets while wooden cages were used in the daily LBMs. Cages not made of galvanized metal or plastic are difficult to clean and disinfect because these materials are porous which make it difficult for disinfectant to penetrate and kill organisms lodged in the small pores of wood and these organisms can cause disease (FAO, 2010; USAID, 2009). Although most of the fowl sellers claimed they remove faeces and litter from cages, observations showed that layers of feaces are usually formed in the cages. This practice indicates poor sanitary and hygienic practices in the LBMs. The improper disinfection of holding cages would encourage the maintenance of ND virus within the LBM and transmission between batches of new birds brought to the LBMs (USAID, 2009). The staking of cages on each other coupled with overcrowding and contamination of cages with faeces are likely to assist the spread of infectious disease agents within the LBMs. The short distance between holding cages within the LBMs increase congestion coupled with mixing of different poultry species in close confinement can result in stress with increased likelihood of shedding and spreading of potentially harmful microbes (WHO, 2004; Warwick *et al.*, 2012).

The presence of stray dog in some of the LBMs is risky as it might expose birds and humans to disease especially when these dogs eat infected offals from processing areas (Soomro *et al.,* 2014). Avian influenza which is zoonotic have been reported to infect dogs with active secretion of the virus in body secretions (Songserm *et al.*, 2006). The presence of flies and rodents in the LBMs will also enhance disease transmission as these are vectors and reservoirs of disease (Mermin *et al.*, 2004). Rodents might contaminate feed and litter with their excrement containing infectious organisms (Cardona and Kuney, 2002; Zander *et al.*, 1997). Absence of rodent control programmes and easy access of stray animals in the LBMs equally compromised biosecurity. Rats and mice are known carriers of at least 35 diseases, and constitute major carriers and reservoirs of poultry pathogens, including AI (Adams, 2003). The fowl sellers reported sighting of wild birds in the LBMs. Vultures were seen in some of the markets while pigeons were being sold in some of the LBM especially in Otukpo LGA. This is a concern because many of these birds are migratory and travel over long distances across international borders (Hoye *et al.*, 2010). Epidemiological studies have suggested that wild birds can play a role in the transmission of NDV to domestic poultry and vice versa (Cardenas *et al.*, 2013). The isolation of viscerotropic velogenic NDV from wild birds during ND outbreaks in poultry has led to the suggestion that wild birds could be important vehicles for the spread of the disease in Nigeria (Echeonwu *et al.,* 1993; Ibu *et al.*, 2009; Oladele *et al.*, 2012). Pigeons can be a source of infection for domestic poultry, either directly or by contaminating poultry feed. A high percentage of domestic pigeons and turtle doves were positive for antibodies to NDV in Zaria, Nigeria (Sa'idu *et al.*, 2004). Similarly, ND outbreaks in Britain were reported in unvaccinated chickens as a result of consumption of feed that was contaminated by droppings from infected but clinically normal pigeons (Alexander *et al.*, 1984). Poor biosecurity was also exhibited by confining chickens together with other bird species such as ducks, increasing the likelihood of exposing

susceptible chickens to ducks that are reported to harbour, yet remain asymptomatic to AI (Nguyen *et al.,* 2005; Gilbert *et al.,* 2006). These biosecurity omissions have also been recently reported in Nigeria (Pagani *et al.*, 2008) and Indonesia (Santhia *et al.,* 2009). Existing literature shows that limiting the number species of livestock sold in a market reduces the persistence of infection in LBMs (FAO, 2010), different species of animals including cattle, goats, sheep and swine were sold alongside poultry in some of the markets. The observation is common in many other African countries (Pagani *et al.,* 2008).

Some sellers who eat sick birds as revealed from the study are likely to be exposed to avian zoonotic disease such as highly pathogenic avian influenza (HPAI). Also, selling of sick birds can result in disease spread since most local poultry farmers obtain their breeder stock from LBMs. Though most fowl sellers do not buy sick poultry as they consider it a risk to their business and those that buy aid in the spread of NDV. The action of the farmers during poultry disease outbreak through sales of sick poultry could spread the disease to free communities through the sale and purchase of sick poultry (Durosinlorin, 2008). The sale of raw and cooked food in LBMs as observed in this study can lead to contamination of these food stuffs (rice, yams, cassava) especially when there is an outbreak of avian zoonotic disease. The improper disposal of dead birds, offals and manure poses a risk to human and animal health as few sellers burn or bury dead birds or their entries (Abioye, 1994; Akanni and Benson, 2014)). The significant risk associated with disposal of dead bird in refuse dump observed in this study is also consistent with previous reports (Ameji *et al.*, 2012; Cardona and Kuney, 2002). The danger of this practice is that infected dead birds may be fed upon by wild birds, domestic free scavenging birds, cats or dogs and this can lead to infection or spread of ND and other avian diseases. The practice of throwing away offals, feathers, manure and dead birds by fowl sellers will also contaminate the environment and thus maintaining the infectious agent resulting to further spread. The use of poultry litter on crop farms without prior composting as shown in the result can also lead to contamination of the environment and surface water (Akanni and Benson, 2014) leading to further spread of NDV and other infectious agents. Most of the fowl sellers do not use PPE such as coveralls, boots, gloves and face masks. This is similar to findings of Kambai (2011) in a study of LBMs in Kaduna State where fowl sellers do not wear PPE. These practices are likely to expose the sellers to potential pathogens which can be transmitted to other poultry during business or carried home in their shoes and clothes (Warwick *et al.*, 2012). Fowl sellers reported that the highest sale of birds occurred during Christmas and New Year celebration. These periods of the year also coincides with the dry harmattan period. Newcastle disease has been reported to be more common during the dry harmattan (November-March) and cold stress has been known to worsen the outcome of ND (Abdu *et al.*, 2005; Sa'idu *et al.*, 2006). Hence, trade may contribute to the high prevalence of ND reported during this period. The means of transporting poultry to LBMs as shown in this study allows for close contact between humans and birds thereby increasing the risk of disease transmission between birds and humans. Wossene (2006) reported that there is a high risk of disease transmission in sharing means of transportation with birds. Also, fowl sellers as well as intermediaries having direct contact with birds could be at risk of occupational hazards as reported by Ajetombi *et al.* (2010). The study further revealed that fowl sellers do not properly clean vehicles used in transporting birds to LBMs. This practice could transport avian viruses especially those transmitted through

aerosol like ND over long distances thereby facilitating the introduction and spread of the disease (USAID, 2009). This practice will also increase the risk of disease transmission between batches of birds transported to the LBMs. All fowl sellers who participated in the study knew ND and the clinical signs associated with the disease. They also recognized ND as a poultry disease known with high mortality. Fowl sellers were not willing to report ND outbreak possibly due to lack of government intervention to issues that concerns the LBMs in the State. This finding is similar to reports of fowl sellers in Kaduna State (Assam *et al.*, 2011). Fowl sellers in daily markets are more likely to report ND outbreak because most of them rely on poultry trade for their livelihood. Water was a constraint in the LBMs studied, this will hamper hygiene and sanitation in the LBM as fowl sellers are likely to skip hand washing and other cleaning due to non-availability of water (Pagani *et al.*, 2008). The overall sanitary conditions in the LBMs and the slaughter areas were observed to be poor, and most of them were associated with inadequate water supply, lack of proper drainage system and minimal control of movement of people in and around the processing areas. Poor sanitation in LBMs can hinder national and global efforts aimed at prevention of spread of infectious agents such as influenza viruses (FAO, 2010).

CONCLUSION

The results from the assessment of the LBMs showed that the highest biosecurity risky practices was in the area of sanitation (cages contaminated with faeces, dirty processing areas) which implies that sanitation is a problem in the LBMs in Benue State which needs to be improved to reduce the risk of disease transmission. Most of the LBMs were not organized with majority operating with limited infrastructure. Thus, we recommend the training of fowl sellers on biosecurity practices and urge the Government to upgrade the LBMs with standard infrastructures.

ACKNOWLEDGMENTS

The authors are grateful to the Benue State, Avian Influenza Control Project (AICP) Desk Officer, Ministry of Agriculture Makurdi, Dr. R.K. Kparevzua and the AICP LGA Desk Officers for facilitating the conduct of the field study.

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