Journal of Applied Sciences

ISSN 1812-5654

science alert

ANSInet
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http://ansinet.com

Journal of Applied Sciences 8 (2): 205-217, 2008
ISSN 1812-5654

Incidence of Avian Influenza in Adamawa State, Nigeria: The Epidemiology, Economic Losses and the Possible Role of Wild Birds in the Transmission of the Disease

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Abstract: Reducing the huge economic losses due to diseases in poultry as the second largest industry in Nigeria after oil means improving the protein intake of the majority. Similarly, this will also promotes a steady income for the teeming farmers. This study investigated the incidence of the lethal avian influenza in Adamawa State, Nigeria, with particular emphasis on the socio-economic and cultural activities of the poultry farmers, economic losses and the possible role of wild birds in the transmission of the disease. Data were collected from 316 and 458 direct and indirect respondents, respectively, from 6 affected villages and a town in 2 Local Government Areas (LGAs): Girei and Yola-North. Results revealed that a larger (25.71%) proportion of the respondents fell within the age range of 31-40 years, with majority (54.91%) as females. While the bulk (54.65%) of the respondents were illiterates, 95.47% of the direct respondents derived their incomes from crop production, whereas 59.17% of the indirect respondents from livestock rearing. About 26,049 birds worth N13, 454,800.00 was cumulative economic loss incurred by the poultry farmers, whereas that of the government was put at ₦1, 119,781.10. Of the mortalities experienced in the wildlife before the outbreak of the disease, *Bubulcus ibis* (64.29) and *Tadarida nigeriae* (86.36) were the highest. The study recommends a massive rural extension on Poultry Production with absolute biosecurity, involving all stakeholders (Veterinary Surgeons, Animal Scientists/health workers, wildlife specialists, Agricultural Economists, Information Officers etc.) in a collaborative form for high synergistic effects.

Key words: Avian, direct, indirect, influenza, Nigeria, respondents

INTRODUCTION

Avian Influenza (AI) is now a global phenomenon. It is not the colossal economic loss incurred in the Poultry Industry in an event of the disease outbreak that is of concern alone, but the human health and lives of some susceptible livestock are also put at great risk. Also known as bird flu or avian flu, the disease is primarily of birds of all ages and species and of those domesticated and of the wild. It is a lethal disease caused by a virus known as influenza A type that can lead to high mortality ranging from 50-100% within 2 days in a flock, from its on-set.

The disease is characterized by a very high morbidity and mortality without premonitory clinical signs. The surviving birds initially quit eating. Swelling of head and eyelids, discharge from eyes and nasal passages are observed. The comb and wattles may turn purple or blue with marked hemorrhages on leg shanks. Other clinical signs include diarrhea and difficulty in breathing. The diarrhea could be profuse, watery and frequent resulting in excessive thirst. For the laying stock, there is decreased or cessation in egg production with soft-shelled or mishappen eggs in event they are produced (United States Agency for International Development, 2006; Ahmad, 2006).

The Cornell Laboratory of Ornithology (2006) traced the history of influenza A virus way back to 1900s when the first outbreak was identified in Poultry in Italy. From then, the disease had reappeared at irregular intervals around the world. These occurrences led to the emergence of new subtypes and strains due to viral

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genetic mutations. The outcome of the latter, generate into full blown pandemics in the past. The first one was in 1918 commonly referred to as Spanish flu in which HINI caused the death of 50,000 persons in US and over 50 million worldwide. This was followed by the Asian flu in 1957 where the confirmed H_2N_2 led to the loss of 69,800 humans in the US and about 1 million globally. The last catastrophe was in 1968. known as the Hong Kong flu, the H_3N_2 outbreak claimed 33,800 lives in US and about 700,000 deaths worldwide.

Doran (2006) noted that the current highly pathogenic avian influenza (HPAI) Strain, Subtype H5NI, is believed to have emerged in 2002. To date, over 200 million domesticated birds have been killed by the virus or culled to stem its spread. Further, this strain has acquired the capabilities to infect human. Of the more than 190 peoples that were said to have been infected, over 100 died and majority were in south-east Asia. Presently, the human to human spread of the virus does not occur. However, it is feared that only a minor adaptations is needed for it to develop the necessary characteristics. Such an adaptation would allow the virus to become pandemic.

The avian influenza viruses, observed Doran (2006), are classified according to the composition of 2 surface proteins, hemagglutinin (H) and neuraminidase (N). The former are currently 16 known H-Subtypes (H_1-H_{16}), whereas the latter are 9 known N-Subtypes (N_1-N_9). Ahmad (2006) affirmed that there could be combination between each H antigen with each one N factor to produce a strain that could affect one or more species of animal or man. In all, a total of 144 different subtypes of the virus can be encountered.

Olsen *et al.* (2006) also reported that the virus can be categorized into 2 depending on the pathogenicity as Low Pathogenic Avian Influenza (LPAI) and High Pathogenic Avian Influenza (HPAI). The LPAI forms cause mild, if any, symptoms in wildbirds. The viruses have been found in at least 105 wildbirds species. Wild fowl appear to carry these viruses more readily than other birds. Ducks, geese and swans are among the species primarily affected and to a lesser extent, gulls, terns and pigeon. The HPAI is a product of asymptomatic wildbirds contact with the susceptible poultry. Upon infection of new hosts, particularly those housed in high densities, the virus may evolve rapidly and mutate into highly pathogenic viruses such as H5NI.

Apart from birds generally, the influenza A viruses are found in a variety of animals, including Pigs, Whales, Horse, Seals and Humans (Olsen *et al.*, 2006). In economics, a loss of single human live can not be appropriately quantified, but Burns *et al.* (2006) made efforts to quantify the possible economic impacts of the pandemic. However, attempts were made to capture the economic losses incurred due to the outbreak of this disease in Nigeria and other parts of the world (European Commission, 2005; National Animal Disease Information and Surveillance, 2006; Ja'afar-Furo, 2007). Therefore, efforts should be made by all stakeholders towards containing the spread of this virus.

The outbreak of Avian Influenza in Sabon-gari Labondo (Garin kara) in January, 2007, in Girei Local Government Adamawa State, Nigeria, provided ample opportunity for the researchers to investigate the socio-economic and cultural factors of the affected farmers that facilitated the spread of the disease, the epidemiology, economic losses and the possible role wildbirds played in the transmission of same. The findings will provide clinicians and other experts involved in the containment exercise of Avian Influenza in the State with adequate information toward strategizing their approaches for better results.

MATERIALS AND METHODS

This study was conducted in Adamawa State, which is located at the North-Eastern part of Nigeria. It is found between Latitudes 7° and 11°N of the Equator and between Longitudes 11° and 14°E of the Greenwich Meridian. It has a land area of 42,159 square kilometers with a population figure of 3,194,781 as at the National Population Commission (2006) census.

The 2 Local Government Areas (LGAs) where the poultry disease outbreaks were duly confirmed by the Adamawa state birdflu control desk office were the survey areas. These LGAs were Girei and Yola-North, respectively. In the latter, only 1 poultry farm was infected in Jimeta town, whereas in the former, 6 villages were inflected with the lethal virus. These include Sabon-gari Labondo (Garin Kara), Kabawa, Gwagrah mai ruwa, Batare, Hottollore and Karewa. The co-ordinates are indicated below:

	Latitude	Longitude
Sabon-gari Labondo	09.3790 N	12.4010 E
Kabawa	09.3540 N	12.4210 E
Gwagrah Mai ruwa	09.4250 N	12.3970 E
Batare	09.3990 N	12.4940 E
Hottollore	09.4190 N	12.4860 E
Karewa	09.4140 N	12.4990 E
Jimeta	09.2660 N	12.4610 N

With the use of structured questionnaire, the researchers who were 4 in numbers collected the data on a house to house basis in all the affected households in the areas. Interview schedules were applied to obtain

information from the respondents as majority could not read or write. Indigenous group knowledge of the poultry farmers and expertise confirmation through the use of field guides (Adden *et al*., 1996; Duan, 1999) were procedures followed to identify all the wild animals and wildbirds in the area studied.

A total of 316 households were those affected and therefore, interviewed. Due to the nature of ownership of poultry in the given households, the respondents were categorized into 2: the direct (316) and indirect (458) respondent. While the direct respondents were the heads of families or husbands, the indirect respondents include the wives, children and dependents whom direct access to them was not possible due to some cultural and religious factors. However, the direct respondents provided the needed information of all members of the households. The distribution of the respondents is shown in Table 1.

Apart from socio-economic and cultural data, information was also collected on species of poultry raised and infected, the epidemiology of the disease, economic losses incurred by poultry farmers and the government and mortalities experienced in the other species of livestock during the disease outbreak. Also obtained was information on wildlife and the number of death before and within the avian influenza outbreak period.

Prices of poultry and wildlife were determined on the average locally. This was arrived at after adding the rates at village levels and rates obtained at Live and smoked poultry and wildlife markets in nearest towns, respectively and finding the means.

The data collection lasted for 2 months i.e. March to April, 2007. Therefore, all prices of poultry and wildlife were determined within that period.

RESULTS AND DISCUSSION

The socio-economic and cultural characters of the respondents in the study area: Extension service is a very capital intensive service delivery system. For any well structured extension programme to create the desired effect in any given rural society, the socio-economic and cultural activities of that community have to be well understood. Previous studies by Ja'afar-Furo and Furo (2006) and Ja'afar Furo (2007) adequately stressed the essence of understanding these factors and their role in promotion of new innovations in agricultural production.

In this survey, the socio-economic and cultural factors of the respondents thought to have great influence on the spread of Avian Influenza virus in the area of study were properly captured. These include the age and gender of the respondents, the marital status and

Table 1: Distribution of respondents according to local government areas and villages/towns

LGA	Village/ Town	Direct respondents	Indirect respondents	Total respondents
Girei	Kabawa	50 (15.82)	46 (10.04)	96 (12.40)
	Sabon Gari			
	Labondo	75 (23.73)	117 (25.55)	192 (24.81)
	Gwagrah	48 (15.19)	108 (23.58)	156 (20.16)
	Batare	71 (22.47)	87 (19.00)	158 (20.41)
	Hottollore	20 (6.33)	28 (6.11)	48 (6.20)
	Karewa	51 (16.14)	72 (15.72)	123 (15.89)
Yola North	Jimeta	1(0.32)	-	1 (0.13)
Total		316 (100.00)	458 (100.00)	774 (100.00)

Values in parentheses are percentage of total in each category. Source: Field survey (2007)

population in a household in relation to their monthly income. Others are the level of educational attainment, occupation, reasons for keeping poultry and the methods of raising the birds by the respondents.

Martin (2006) noted that for a complete success in the fight against the spread of Avian Influenza, the poultry production systems, cultural and trade practices that influence the emergence of HPAI should be addressed effectively. Further, he attributed the emergence of HPAI in Asia to the convergence of different risk factors, such as the increasing intensity of poultry production systems, low biosecurity and the absence of effective veterinary services.

It could be observed from Table 1 that the total population of the respondents in 6 villages and a town of the affected areas were 774, with 316 and 458 forming the direct and indirect respondents, respectively. The latter category was constituted by the house wives, children and dependants, whereas the former were primarily the household heads or husbands. Larger proportions of the respondents were found in Sabon-gari Labondo (24.81%), Batare (20.41%) and Gwagrah mai ruwa (20.16%). Karewa, Kabawa, Hottollore and Jimeta had 15.89, 12.40, 6.20 and 0.13%, respectively.

About 25.71% of the total respondents which represents the larger chunk fell within the age range of 31 and 40 years (Table 2). Similarly, 28.80% and 23.58% of the direct and indirect respondents, respectively, were found within the latter age bracket, implying that the respondents were more of youth in the area surveyed. Gender-wise, females formed the majority (54.91%) with 45.09% as men in population. This trend can be attributed to the polygamous nature of the households in the study area, in which some heads of families (direct respondents) had between 2 and 4 housewives (indirect respondents) per household.

Women (wives) were said to be prime persons that feed the birds in the morning with food remnants, grain bran etc. before releasing the poultry to go on free ranging in village surroundings. They are also known to

clean structures regarded as pens, waterers and feeders. However, the researchers could not have direct interviews with them for the simple reason that they were in purdah. The fact that there was no female among the researchers who could have been given the opportunity to interact directly with the female respondents further compounded the problem. Therefore first hand information that could have been obtained from the wives directly was relayed by the husbands.

Working towards a successful information delivery system, messages should be delivered to the appropriate target members of communities. The FAO (2006) corroborated this fact by asserting that communication strategies need to address animal health issues, deep-rooted socio-cultural and livelihood practices and long-term socio-economic implications, which should be effectively delivered and consistently communicated to those who need it most. In this survey, they were the female respondents. Going by this finding, research teams should compose of the two gender in order to help document or capture appropriate information otherwise could have been forgone for cultural reasons.

Majority (93.99%) of the respondents were married, with a larger (37.97%) proportion of the households comprising 6-10 members in a family (Table 3). This population is high considering the fact that poultry were left to roam freely in the study area, thereby increasing the possibility of contact between humans and birds which invariably increases the risk of infection and reduces biosecurity that is regarded as significant. This agreed with Cornell Laboratory of Ornithology (2006) report that, of the 172 persons that have died worldwide, nearly all cases had the history of close contact with diseased poultry, infected bird products and contaminated surfaces, such as dirt, water or cages.

Majority (54.65%) of the respondents were illiterates. About 36.43% had Qur'an knowledge and 0.52% acquired Bible knowledge. Only 8.42% had a tint with the western education. In other words, 91.58% had no formal education at all (Table 4). Therefore, for any enlightenment campaign to succeed, it should be packaged in such a way that religious leaders be involved. Further investigations by the researchers showed that most people in the study area were Hausas and Fulanis with a negligible size comprising other tribes. Islam was the dominant religion in the area. In this regard, the inclusion of Muslim scholars as members of campaign teams would help in producing good effect.

As the bulk (91.58%) of the respondents had no western education, they were discovered to be involved in menial jobs to derive income. However, their main occupations were livestock rearing, crop production, petty trading and fishing in descending order. These were mostly practiced using the traditional methods. Table 5 shows the list of occupational practices of the direct and indirect respondents, respectively. All the direct respondents partake in crop production. They grow cereals in the rainy seasons and raise vegetable gardens around Fadama (wet land) areas in the dry season. Similarly, all the indirect respondents raised poultry and a larger (59.17%) size of their population complement it with petty trading, in which cooked food and poultry

Table 2: Distribution of respondents according to age and gender in the study area

Criterion	Direct respondents	Indirect respondents	Total respondents
Age range			
In years			
1-10	-	95 (20.74)	95 (12.27)
11-20	19 (6.01)	25 (5.46)	44 (5.68)
21-30	82 (25.95)	86 (18.77)	168 (21.71)
31-40	91 (28.80)	108 (23.58)	199 (25.71)
41-50	54 (17.09)	62 (13.54)	116 (14.99)
51-60	31 (9.81)	40 (8.74)	71 (9.17)
Above 60	39 (12.34)	42 (9.17)	81 (10.47)
Total	316 (100.00)	458 (100.00)	774 (100.00)
Gender			
Male	314 (99.37)	35 (7.64)	349 (45.09)
Female	2 (0.63)	423 (92.36)	425 (54.91)
Total	316 (100.00)	458 (100.00)	774 (100.00)

Values in parentheses are percentage of total in each category. Source: Filed Survey (2007)

Table 3: Distribution of respondents based on marital status and household size in the study area

Items	Frequency	Percentage (%)
Marital status		
Married	297	93.99
Single	17	5.38
Widow	2	0.63
Total	316	100.00
Household size in range		
1-5	108	34.18
6-10	120	37.97
11-15	56	17.72
16-20	21	6.65
Above 20	11	3.48
Total	316	100.00

Source: Field Survey (2007)

Table 4: The respondents distribution based on level of education attained in the study area

Level of education attained	Direct respondents	Indirect respondents	Total respondents
Tertiary institution	2 (0.63)	-	2 (0.26)
Secondary/TC II education	13 (4.11)	2 (0.44)	15 (1.94)
Secondary/TC II Drop-out	1 (0.32)	-	1 (0.13)
Junior secondary education	3 (0.95)	-	3 (0.39)
Primary school education	21 (6.65)	4 (0.87)	25 (3.23)
Primary school drop-out	2 (0.63)	6 (1.31)	8 (1.03)
Adult literacy education	11 (3.48)	-	11 (1.42)
Qur'an knowledge	215 (68.04)	67 (14.63)	282 (36.43)
Bible knowledge	2 (0.63)	2 (0.44)	4 (0.52)
Have not acquired any	46 (14.56)	377 (82.31)	423 (54.65)
Total	316 (100.00)	458 (100.00)	774 (100.00)

Values in parentheses are percentage of total in each category. Source: Field Survey (2007)

Table 5: Distribution of respondents according to occupation in the study area

Occupation	Direct Respondents	Indirect respondents	Total respondents
Crop production	316 (95.47)	15 (4.53)	331 (100)
Livestock rearing	316 (40.83)	458 (59.17)	774 (100)
Fishing	51 (100.00)	-	51 (100)
Petty trading	40 (14.93)	228 (85.07)	268 (100)
Teaching Qur'an	14 (42.42)	19 (57.58)	33 (100)
Commercial Motorcycling	13 (100.00)	-	13 (100)
Poultry/poultry Products hawking	12 (100.00)	-	12 (100)
Civil service	11 (100.00)	-	11 (100)
Hunting	10 (100.00)	-	10 (100)
Tailoring	6 (66.67)	3 (33.33)	9 (100)
Building	4 (100.00)	-	4 (100)
Barbing	4 (100.00)	-	4 (100)
Driving	4 (100.00)	-	4 (100)
Motorcycle repairing	4 (100.00)	-	4 (100)
Meat selling	4 (100.00)	-	4 (100)
Begging	3 (100.00)		3 (100)
Bus-conducting	2 (100.00)	-	2 (100)
Blacksmithing	2 (100.00)	-	2 (100)
Herding	2 (100.00)	-	2 (100)
Clothe washing	1 (100.00)	-	1 (100)
Shoe shining	1 (100.00)	-	1 (100)
Carving	1 (4.76)	20 (95.24)	21 (100)
Tanning	1 (100.00)	-	1 (100)
Traditional healing	1 (100.00)	-	1 (100)

Values in parentheses are percentage of the total respondents. *: Multiple responses were recorded. Source: Field Survey (2007)

Table 6: Distribution of respondents based on monthly income in the study area

Monthly income In Naira (N)	Direct respondents	Indirect respondents	Total respondents
100-1000	47 (14.87)	125 (27.29)	172 (22.22)
1100-5000	87 (27.53)	300 (65.50)	387 (50.00)
5100-10,000	73 (23.10)	15 (3.28)	88 (11.37)
10100-15000	32 (10.13)	9 (1.97)	41 (5.30)
15100-20,000	32 (10.13)	6 (1.31)	38 (4.91)
20,100 and above	45 (14.24)	3 (0.65)	48 (6.20)
Total	316 (100.00)	458 (100.00)	774 (100.00)

Values in parenthesis are percentage of total in each category. Naira (N)* 130 = US$1, Source: Field Survey (2007)

products (eggs and chickens) and provisions such as soaps, sugar, bread etc. were given to children to hawk around the village squares. Only the direct respondents (males) go on fishing in the area.

It could be observed from the Table 6 that most (72.22%) respondents fell within the income group of N100.00 and N5,000.00 only per month per household in the surveyed area. This was considered as grossly inadequate taking cognizance of the fact that a larger (37.97%) proportion of the household had between 6 and 10 members in a family. Going by the United Nations minimum standard of US$1 (N130.00) per person per day, a household of 6 persons required about US$180 per month, an equivalent of about N23,400.00 per month. This pathetic situation calls for prompt compensation by the government and agencies concerned, for poultry farmers

Table 7: Distribution of respondents according to reasons for keeping poultry and period of stay by the respondents in the study area

Criterion	Direct respondents	Indirect respondents	Total respondents
Reason for keeping poultry*			
Complementary source of income	314 (41.76)	458 (91.78)	772(61.86)
For consumption	291 (38.69)	20 (4.01)	311 (24.92)
Spiritual	90 (11.97)	12 (2.41)	102 (8.17)
Gift	56 (7.45)	9 (1.80)	62 (4.97)
Hobby	1 (0.13)	-	1 (0.08)
Total	752 (100.00)	499 (100.00)	1248 (100.00)
Period of stay in the area in years			
1-5	13 (4.11)	20 (4.37)	33 (4.26)
6-10	25 (7.91)	15 (3.28)	40 (5.17)
11-15	23 (7.28)	35 (7.64)	58 (7.49)
16-20	47 (14.87)	90 (19.65)	137 (17.70)
21-25	69 (21.84)	80 (17.47)	149 (19.25)
26-30	70 (22.15)	160 (34.93)	230 (29.72)
Above 30	69 (21.84)	58 (12.66)	127 (16.41)
Total	316 (100.00)	458 (100.00)	774 (100.00)

Values in parentheses of total in each category. *Multiple responses were recorded. Source: Field Survey (2007)

who lost their stock as a result of bird flu or culling. However, this was not the case in the area studied. As at the time (four months after the outbreak) of this report, no payment was effected to the affected poultry farmers. This attitude would dampen the morale of affected poultry farmers in the future thereby reducing the reporting of outbreaks cases for fear of culling poultry without payment. The finding further buttressed Bruschke (2006) report who documented that for effective early warning and reporting, the compensation of farmers who suffered direct loses should be paid due to the social and economic consequences that may arise due to delay.

Reasons for keeping poultry by the respondents are stated in Table 7. While raising birds as major complementary source of income and for consumptions purposes accounted for 61.86% and 24.92%, respectively, poultry production for spiritual needs (8.17%) and gifts reasons (4.97%), followed these. Only 0.08% of the respondents kept birds as hobby. Also, reflected in Table 7 is the period of stay by the respondents in the study area. From the Table 7, it could be seen that about 83.08% had been residents of the area for well over 15 years. This is an indication that most of the respondents were conversant with the terrains and happenings of the localities thereby giving them adequate knowledge of the wildlife in the area: specifically, the wild animals, wildbirds and their migratory trend. The result further confirmed Stroud (2006) observation that the poultry sector is Nigeria's second largest industry after oil and by implication farmers heavily derive their livelihood from the practice.

The epidemiology of avian influenza in the study area: Epidemiology can simply be termed as the scientific study

of the spread and control of disease in an area. Avian flu is primarily a disease of the poultry and wildbirds. Birdlife International (2007) stated clearly that understanding of the Epidemiology of H5NI in wildbirds and the behaviour of the virus in the wider environment remains very inadequate. However, attempts are made in this report to highlight the possible ways of the spread and control measures taken to contain the disease specifically in domestic birds in the areas surveyed.

Certain factors were taken into consideration towards achieving the mode of spread. It could be observed from Table 8 that wives, otherwise referred to as indirect respondents formed the bulk of those who raised chickens and ducks in the study area. The heads of families (husbands) accounted for larger proportions of the ownership of Guinea fowls, Pigeons and geese in descending order. Therefore, 5 species (chicken, duck, guinea fowls, pigeon and geese) of poultry were said to have been raised by the poultry farmers in the area, with local (native) breed accounting for the majority.

It is of worthy to note here that the first avian flu outbreak in Nigeria was reported in Kaduna at Sambawa farms in February, 2006 (Ja'afar-Furo *et al*., 2007). Since then, various committees and centers were formed/created at the National, State and Local Government Areas level to receive report of outbreaks and also serve as enlightenment organs towards containing the disease. Prominent among these, are the avian flu crisis management centers and the Avian Influenza Control Project Desk Office of the World Bank in collaboration with the Federal Government and State Governments, opened in all 36 States of the Federation including Abuja the Federal Capital Territory. Yet, investigations by the researchers showed that the poor rural poultry farmers of Kabawa, Sabon-gari Labondo, Gwagrah Mai ruwa, Karewa, Batare and Hottollore villages (Areas Studied) have not had a single enlightenment visit from these awareness bodies knowing fully well that these areas mentioned were and still are the major suppliers of one of the biggest live markets of poultry, Girei market, in the State. This further confirmed Ja'afar-Furo *et al.* (2007) report on the very weak extension/awareness services on this disease in the state. Thereby, noting the ineffectiveness of these enlightenment organs in Adamawa State. This finding aligned with the FAO (2006) report that most national communication plans have been in the nature of outbreak crisis response and that perception of risk drops rapidly after the immediate crisis is over.

Therefore, when the first Avian Influenza outbreak was observed in Sabon-gari, Labondo (Garin Kara) in January, 2007 spanning through February of the same year (Balla, 2007), the poultry farmers were ignorant of what to do. Mortalities were running into thousands and unbelievable within few days. Due to the vacuum created by the absence of changed agents, they reported the cases directly to the then Commissioner of Animal Health and Production who came from that area. Although, Animal Health Personnel were sent to the area immediately to control the situation, colossal losses were already incurred. Table 9 shows the total poultry lost by the direct respondents due to Avian Influenza and culling. A total number of 17,026 birds were lost. Of this population, 79.58% were chickens. This was followed by ducks (15.40%) and guinea fowls (4.86%). Only 0.11% and 0.05% were death experienced in pigeons and geese, respectively, with a mean of 53 birds for the respondents. Similarly, Table 9 indicates losses incurred by the indirect

Table 8: Distribution of respondent based on species of poultry owned among members of household in the study area

Items	Heads of families	Wives	Children	Dependants
Species of poultry*				
Chicken	302 (65.65)	329 (66.33)	96 (70.07)	6 (66.67)
Ducks	122 (26.52)	158 (31.85)	39 (28.47)	2 (22.22)
Guinea fowl	32 (6.96)	9 (1.82)	2 (1.46)	1 (11.11)
Pigeons	3 (0.65)	-	-	-
Geese	1 (0.22)	-	-	-
Total	460 (100.00)	496 (100.00)	137 (100.00)	9 (100.00)
Breeds of poultry				
Exotic	2 (0.63)	-	-	1 (11.11)
Local	314 (99.37)	362 (100.00)	96 (100.00)	8 (88.89)
Total	316 (100.00)	362 (100.00)	96 (100.00)	9 (100.00)

Values in parentheses are percentage of the total. *: Multiple responses were recorded. Source: Filed Survey (2007)

Table 9: The population of poultry of direct and indirect respondents that died from avian influenza and those depopulated by the veterinary personnel in the study area

Species	No. of poultry from avian influenza	No. of poultry destroyed or depopulated by the veterinary personnel	No. of poultry consumed, sold or hidden by respondents after the disease outbreak	Total poultry owned by respondents before the disease outbreak
Direct respondents				
Chicken	10108 (80.99)	2154 (82.31)	1288 (66.80)	13550 (79.58)
Ducks	1879 (15.05)	455 (17.38)	288 (14.94)	2622 (15.40)
Guinea fowls	488 (3.91)	-	340 (17.63)	828 (4.86)
Pigeons	6 (0.05)	-	12 (0.63)	18 (0.11)
Geese	-	8 (0.31)	-	8 (0.05)
Total	12481 (100.00)	2617 (100.00)	1928 (100.00)	17026 (100.00)
Mean	39	8	6	53
Indirect respondents				
Chicken	6187 (75.77)	1979 (71.06)	379 (44.59)	8545 (72.41)
Ducks	1901 (23. 28)	806 (28.94)	386 (45.41)	3093 (26.21)
Guinea fowls	76 (0.93)	-	77 (9.06)	153 (1.30)
Pigeons	2 (0.02)	-	8 (0.94)	10(0.08)
Geese	-	-	-	-
Total	8166 (100.00)	2785 (100.00)	850 (100.00)	11801 (100.00)
Mean	18	6	2	26

Values in parentheses are percentage of total in each category. Source: Filed Survey (2007)

respondents. About 11,801 of birds died either through depopulation or Avian flu. Chickens, ducks and guinea fowls accounted for 72.41, 26.21 and 1.30%, respectively. A meager 0.08% was recorded by pigeons and none for geese. Twenty-Six was the mean for indirect respondents.

In their effort to curtail further loss of poultry, some respondents transferred the stock they regarded healthy for safe keeping with relation in the neighboring villages, others sold out at a give-a-way rates. The moribund were slaughtered and eaten (Table 9). What also constituted a serious health problem of the result in Table 9 were the poultry hidden to escape culling. The respondents were said to have retained some birds during the depopulation process unknowingly to the Animal Health Personnel. These sets of birds later served as new stock. Investigations by the researchers revealed that an instruction by the Animal Health Personnel after culling and disinfection of the surrounding, to stop restocking until after 2 weeks when the virus must have been destroyed, was violated. The respondents immediately bought new birds and released into the hidden stocks. These actions later resulted into reinfection specifically in Karewa, Sabon-gari Labondo and Kabawa. As at the time these data were being collected in March, 2007, pockets of mortalities were still experienced. Collectively a total of 1928 and 850 birds were recorded for direct and indirect respondents in Table 9, respectively. These actions led to further spread of the disease very rapidly in the area. These findings conform to Birdlife International (2007) earlier statement that the most important route of spread globally, remains unrestricted poultry and poultry products movements.

Another worrisome situation thought to have contributed to the further spread of the disease within the locality very fast, were the methods of disposal of poultry carcasses by the respondents before the arrivals of Animal Health personnel. Majority (94.94%) of the household just dumped their death poultry in the backyard in the open on refuse collection area. While about 7.59% buried their poultry carcasses in pits, only a minority (2.22%) burnt same, with a 0.32% of the households dumping dead birds in water bodies around the villages (Table 10). Of these methods, the open dump of carcasses and in water bodies constituted the highest risk not to birds alone but human beings as well. It was discovered that people from other minority tribe in the area who could not afford to buy meat, selected from the fresh poultry carcasses for meals with families thereby further widening the possibility of contamination.

Ducks from the villages also fly over to water bodies in the wet lands of the area for swimming and feeding. In so doing, they come into contact with wildbirds thereby broadening the possibility of getting infected in the process. Similarly, cattle egrets that feed on insect while the cattle graze, follow the latter to the residential areas around the local pens which provides another source of contact with the poultry. This could have been another potent source of infections to the domesticated birds. Further, migratory birds to the area such as Abdim's stork which build nests on the tree tops within residential areas might also be a strong route of transmission to the poultry or spread in the locality.

Table 10: Methods of disposal of dead poultry by respondents before the arrival of veterinary personnel in the study area

Method of disposal*	Frequency of households	Percentage (%)
Dumped in the backyard	300	94.94
Buried in pits	24	7.59
Burnt the dead birds	7	2.22
Dumped in pond/river	1	0.32

The percentage is of the total direct respondents. *: Multiple Responses were recorded. Source: Field Survey (2007)

Table 11: Other types of livestock kept in the households and the health status as reported by the respondents in the study area

Species of livestock*	Frequency of households	No. of death of livestock due to infections during the A.I. Outbreak	System of management (mgt) of livestock kept
Cattle	81 (25.63)	1 (0.42)	Semi-intensive mgt.
Sheep	84 (26.58)	25 (10.46)	Semi-intensive mgt.
Goats	219 (69.30)	209 (87.45)	Semi-intensive mgt.
Cats	19 (6.01)	-	15 were managed intensively. 4 cats strayed.
Dogs	15 (4.75)	2 (0.84)	5 were managed intensively. 10 dogs strayed.
Pigs	3 (0.95)	2 (0.84)	Intensive mgt
Donkeys	7 (2.22)	-	Semi-intensive mgt.
Horse	1 (0.32)	-	Semi-intensive mgt.
Rabbit	1 (0.32)	-	Intensive mgt
No Livestock were kept.	34 (10.76)	-	-

Values in parentheses are percentage of total of direct respondent and number of death of livestock, respectively. *: Multiple responses were recorded. Source: Field Survey (2007)

Respondents in the study area kept other livestock side by side with poultry. There were about 9 species documented in this study. These include cattle, sheep, goats, donkeys and a horse. Others were pigs, dogs, cats and rabbits (Table 11). Table 11 reports that prominent among the 9 species were goats (69.30%), sheep (26.58%), cattle (25.63%), cats (6.01%) and dogs (4.75%). Principal mortalities were recorded in goats (87.45%) and sheep (10.46%) due to infections which could not be ascertained by this report. However, the death of dogs (0.84%) and pigs (0.84%) were of immense significance to the researchers because of the widely reported cases of isolation of the influenza A viruses in these species (Cornell Laboratory of Ornithology,

2006; Birdlife International, 2007). It was even more serious when the Table 11 shows that about 66.67% of the dogs strayed in the villages. This was an indication that the pets could have scavenged on the infected poultry carcasses. These findings are specifically geared towards revealing the actual situation in the area during the avian influenza outbreak for consideration by experts of the government and donor agencies that ought to have been drafted for such purpose.

The movements of poultry and poultry products were also determined. Investigations by the researchers showed that all (100%) the respondents mainly depended on the sales of poultry and its products (eggs) for immediate cash needs. Middle men were said to have been coming from the neighbouring towns like Yola, Girei, Jimeta, Song, Ngurore among others, for the purchase of birds in the areas. Similarly respondents who were pressed for cash also carried their poultry to these neighbouring towns and villages for sales. Farmers who needed restocking also used to buy poultry from these live markets. Therefore, there has been an established unrestricted inter-villages/towns poultry and poultry products trading in the study area. These scenarios continued even during the disease outbreak until the arrival of the animal health personnel team who banned such trading through the local leaders, at least temporarily for control purpose.

The estimated economic loss experienced by the respondents in the study area: Table 12 shows the estimated economic loss on the part of direct respondents due to avian influenza and culling, in the area surveyed. This group of poultry farmers were the heads of families/households or husbands. Table 12 indicates the species of poultry kept whereas the second column shows the average unit price of every species. The third and fourth columns give the cumulative number of birds and total costs of each species lost, respectively. Further, the Table 12 indicates that a total number of 15098 birds valued at N7,853,900 were lost as a result of the disease and culling.

Similarly, Table 12 reports the estimated economic loss incurred by the indirect respondents which was constituted by the wives, children and dependants in all the households studied. A total sum of ₦5,600,900 accounted for by 10951 birds was the loss recorded for this category of poultry farmers. Therefore, it could be derived from Table 12 that the direct respondents suffered more loss economically in the avian influenza outbreak area.

The economic implication of control of avian influenza in the study area on part of the government and donor agencies as at the time of this report is indicated on

Table 12: Estimated Economic Loss Experienced by the Direct and Indirect Respondents in the Study Area.

Species of poultry	Average unit price before the disease outbreak (N)*	Cumulative number of poultry lost	Total amount (N)*
Direct respondents			
Chicken	550	12262 (81.22)	6744100 (85.87)
Ducks	400	2334 (15.46)	933600 (11.89)
Guinea fowls	350	488 (3.23)	170800 (2.17)
Pigeons	100	6 (0.04)	600 (0.01)
Geese	600	8(0.05)	4800 (0.06)
Total		15098 (100.00)	7853900 (100.00)
Mean		48	24854
Indirect Respondents			
Chicken	550	8166 (74.57)	4491300(80.19)
Ducks	400	2707 (24.72)	1082800 (19.33)
Guinea fowls	350	76 (0.69)	26600 (0.47)
Pigeons	100	2 (0.02)	200 (0.01)
Geese	600	-	-
Total		10951 (100.00)	5600900 (100.00)
Mean		24	12229

Values in Parentheses are percentage of total. Naira (N)* 130 = US$1. Source: Filed Survey (2007)

Table 13: The Economic Implication of Control of Avian Influenza by the Federal Government in the Study Area.

Items	Amount (N)	Percentage (%)
Equipment and materials used for culling and decontamination of affected surroundings.	160,500.00	14.33
Labour		
Skilled labour	433,424.00	38.71
Unskilled labour	109,800.00	9.81
Logistics	112,460.00	10.04
Media Coverage	227,500.00	20.32
Sample collection and Submission to National Veterinary Research Institute Laboratory, Vom, Nigeria, for Analysis	40,000.00	3.57
Surveillance of in contact Villages of the affected Area	36,097.14	3.22
Total	1,119,781.10	100.00

Naira (N) 130 = US$1. Source: Birdflu Desk Office, Yola (2007)

Table 13. About N1,119,781.1 was incurred in the course of purchase of equipment and materials used for culling poultry and decontamination of affected surroundings, payment for labour both skilled and unskilled and logistics. Other activities included collection and submission of samples to the National Veterinary Research Institute, Vom (NVRI) in Plateau State for analysis and the surveillance of the incontact villages of the affected areas. Of the total costs incurred due to control measures taken, 48.52% was spent on labour both skilled and unskilled. Media coverage followed this, with 20.32%, whereas purchases of equipment and materials were the next (14.33%) item of cost. Logistics, collection and submission of samples for laboratory analysis and surveillance of incontact villages of the affected areas accounted for 10.04, 3.57 and 3.22%, respectively. The huge sum spent on labour could be attributed to the hire of experts or consultants as resources person on

enlightenment purposes and also the labourers who dug the pits used for disposal of dead poultry.

The role of wild birds in transmission of avian influenza in the study area: Several authors have given different opinions on the role the wildbirds play in transmission of avian influenza. While National Animal Disease Information and Surveillance (2006) noted that there has been no clear conclusion anywhere as to whether wildbirds or domesticated birds were responsible for HPAI introduction into a new area and forwarding expert opinions as suggesting the combination of both, United States Agency for International Development (2006) and Ahmed (2006) reported that wildfowls act as natural asymptomatic carriers of avian influenza viruses. This simply implies that this set of wildbirds can conveniently transmit the virus to any susceptible host they come in contact with, resulting into HPAI after undergoing mutation in a new host. Therefore, strongly indicating a source of infection in a free area. Sharing the latter view was Doran (2006) who also documented wildbirds as the original host of avian influenza viruses but in a low pathogenic form. The wildbirds serve as vectors of the avian influenza viruses and the HPAI could only occur when contact has been established with susceptible poultry after undergoing some mutations. Also in his effort, Lean (2006) gave considerable evidence citing how migratory birds infected with the deadly flu virus could fly into Europe from Africa. The author reiterated how 2 major outbreaks in Europe coincided with migration of birds. Similarly, several experts and media reporters (Anonymous, 1995, 2006; FAO, 2006) posited that the mysterious Tooth fairy bird was and still is, in their opinions, the vector of H5NI. The Tooth fairy bird was specifically mentioned as the source of infection, by these set of believers, responsible for the Pennsylvania (1983-1984), Hong Kong (in 2002) and Qinghai (in 2005) birdflu outbreaks. However, Williams and Moores (2006) debunked these claims by stating that the Tooth fairy bird is clearly an intriguing scientific and social phenomenon which never found, existing mostly in the brains of certain virologists, officials and Journalists and with a strong and widespread hold in the popular imagination.

Be that as it may, the fact still remains that the wildbirds are the major and natural reservoir of LPAI. The danger is that poultry flock will get infected when it comes into contact with these sets of vectors. Therefore, appropriate and absolute biosecurity measures should prevail among all the poultry keepers globally for this lethal virus to be contained effectively.

Table 14 reports an attempt to document all the wildbirds species that died few days before and during the avian influenza outbreak in the study area. The researchers confirmed from the respondents that wildbirds were observed dying massively 3 to 7 days before their poultry came down with the disease. Although the state officials of the birdflu team who visited the area took samples of the affected poultry which were later confirmed positive by the only certified functional laboratory in Nigeria capable of conducting such analysis, the NVRI, Vom, samples from moribund or dead wildbirds were not collected. The reason for this act was not ascertained. However, what's certain was that there was no ornithologist or wildlife specialist in the team.

Table 14: The species of wild birds and the mortalities experienced before and during the avian influenza outbreak in the study area

Scientific name	Common name	Estimated numbersofdeath
Bubulcus ibis	Cattle egret	1019 (64.29)
Streptopelia somitorquata	Red eyed dove	167 (10.54)
Columba guinea	Speckled pigeon	78 (4.92)
Centropus senegalensis	Senegal coucal	70 (4.42)
Numida meleagris	Helmeted guinea fowl	64 (4.04)
Dendrocygna viduata	White faced whistling duck	43 (2.71)
Francolinus sephaena	Crested francolin	41 (2.59)
Quelea quelea	Red-billed quelea	30 (1.89)
Ardea cinerea	Grey heron	20 (1.26)
Actophilornis africana	African jacana	17 (1.07)
Amaurornis flavirostris	African black crake	9 (0.57)
Ceryle rudis	Pied kingfisher	7 (0.44)
Kaupifalco monogrammicus	Lizard buzzard	7 (0.44)
Anastomus lamelligerus	African opened billed stock	5 (0.32)
Corvus capensis	African black crow	3 (0.19)
Necrosyrtes monachus	Hooded vulture	3 (0.19)
Anhinga rufa	African darter	1 (0.06)
Coracias caudata	Lilac breasted roller	1 (0.06)
Total		1585 (100)
Mean		226

Values in parentheses are percentage of the total. Source: Field Survey (2006)

It could be observed from the Table 14 that not less than 18 species of wildbirds were reported dead in the area under survey. The scientific and common names are also shown in Table 14. Of the cumulative number (1585) seen by the respondents and some confirmed by the researchers, majority (64.29%) were *Bubulcus ibis*. *Streptopelia somitorqueta* accounted for 10.54%, whereas 4.92% was by *Columba guinea*. Among the mortalities experienced in the migratory birds in the area, *Contropus senegalensis*, *Dendrocygna viduata*, *Quelea quelea* and *Ardea cinerea* accounted for 4.42, 2.71, 1.89 and 1.26%, respectively.

The estimated monetary value of all the dead wildbirds which was determined locally in the area is indicated in Table 15. A total sum of N93,197.5 was the equivalent worth of 1585 wildbirds that died. *Bubulcus ibis* (43.74%), *Numida meleagris* (18.88%) and *Francolinus sephaena* (8.14%) were the highest mortalities recorded in the *wildbirds*, with a mean of 226 in the study area.

About 8 prominent species of migratory birds were reported by the respondents. These are shown

Table 15: Estimated monetary value of wildbirds lost during the avian influenza outbreak in the study area

Scientific name	Average unit price (N)*	Estimated number of death	Amount (N)*
Bubulcus ibis	40.0	1019	40760.0 (43.74)
Streptopelia somitorquata	37.5	167	6262.5 (6.72)
Columba guinea	27.5	78	2145.0 (2.31)
Centropus senegalensis	22.5	70	1575.0 (1.69)
Numida meleagris	275.0	64	17600.0 (18.88)
Dendrocygna viduata	125.0	43	5375.0 (5.77)
Francolinus Sephaena	185.0	41	7585.0 (8.14)
Quelea quelea	25.0	30	750.0 (0.81)
Ardea cinerea	125.0	20	2500.0 (2.68)
Actophilornis africana	225.0	17	3825.0 (4.10)
Amaurornis flavirostris	350.0	9	3150.0 (3.38)
Ceryle rudis	22.5	7	157.5 (0.17)
Kaupifalco monogrammicus	75.0	7	525.0 (0.56)
Anastomus lamelligerus	60.0	5	300.0 (0.32)
Corvus capensis	110.0	3	330.0 (0.35)
Necrosyrtes monachus	90.0	3	270.0 (0.29)
Anbinga rufa	60.0	1	60.0 (0.06)
Coracias caudata	27.5	1	27.5 (0.03)
Total		1585	93197.5 (100)
Mean		226	13313.9

Value in parentheses are percentage of the total. Naira (N)* 130 = US$ 1. Source: Field Survey (2007)

Table 16: Prominent species of migratory birds reported by the respondents in the study area

Scientific name	Common name
Ciconia abdimii	Abdim's stork
Terathopius ecaudatus	Bateleur
Centropus senegalensis	Senegal coucal
Pelecamus anocrotalus	Great white pelican
Upupa epops	Crested hoopoe
Quelea quelea	Red-billed quelea
Dendrocygna viduata	White faced whistling duck
Ardea goliath	Goliath heron

Source: Field Survey (2007)

in Table 16. They include *Ciconia abdinii*, *Terathopius ecaudatus*, *Contropus senegalensis* and *Pelecamus anocrotalus*. Other birds are *Lipupa epops*, *Quelea quelea*, *Dendrocygna viduata* and *Ardea goliath*. However, there could be more, but these were the ones this study identified.

Mortalities were also observed in wild animals in the area surveyed within the period of the disease outbreak. Eleven species were identified. These are indicated in Table 17. Wild animals like *Atelerix albiventris*, *Crocidura flavescens*, *Critecomy gambianus*, *Euxerud erythropus and Gabella ruffrons* were recorded. Also documented were *Genetta tigrina*, *Hystrix cristate*, *Varanus niloticus* and *Felis sylvestris.* Others were *Lepus sexalitis* and *Tadarida nigeriae*. The highest (86.36%) mortalities were seen in the latter animal, with *Atelerix albiventris, Corocidura flavescens* and *Critecomy gambianus* accounting for second (2.85%), third (2.76% and forth (2.33%) positions, respectively. However, of these mortalities, *Genetta tigrina* (0.78%) and *Felis sylvestris* (0.035%) otherwise commonly referred to as common genet and wildcat, respectively, drew the

Table 17: The species of wild animals and the mortalities experienced before and during the avian influenza outbreak in the study area

Scientific name	Common name	Estimated number of death
Atelerix albiventris	African hedgehog	33 (2.85)
Crocidura flavescens	African giant strew	32 (2.76)
Critecomys gambianus	Gambian giant rat	27 (2.33)
Euxerus erythropus	Striped ground squirrel	20 (1.72)
Gazella Ruffrons	Red fronted gazelle	12 (1.04)
Genetta genetta	Common genet	9 (0.78)
Hystrix cristata	Crested porcupine	7 (0.60)
Varanus niloticus	Nile monitor lizard	9 (0.78)
Felis sylvestris	Wildcat	4 (0.35)
Lepus saxatilis	Scrub hare	5 (0.43)
Tadarida nigeriae	Nigerian free-tailed bat	1000 (86.36)
Total		1158 (100.00)
Mean		165

Values in parentheses are percentage of the total. Source: Filed Survey (2007)

Table 18: Estimated monetary value of wild animals lost during the avian influenza outbreak in the study area

Scientific name	Average unit price (N)*	Estimated number of death	Amount (N)*
Atelerix albiventris	17.5	33	577.5 (0.54)
Crocidura flavescens	7.5	32	240.0 (0.22)
Critecomys gambianus	135.0	27	3645.0 (3.38)
Euxerus erythropus	175.0	20	3500.0 (3.24)
Gazella ruffrons	4250.0	12	51000.0 (47.84)
Genetta genetta	375.0	9	3375.0 (3.13)
Hystrix cristata	2750.0	7	19250.0 (17.84)
Varanus niloticus	450.0	9	4050.0 (3.76)
Felis sylvestris	225.0	4	900.0 (0.83)
Lepus saxatilis	275.0	5	1375.0 (1.27)
Tadarida nigeriae	20.0	1000	20000.0 (18.53)
Total		1158	107912.5 (100)
Mean		165	15416.1

Values in Parentheses are percentage of the total Naira (N)* 130 = US$1. Source: Field Survey (2007)

attention of the researchers (Table 17). They were regarded as major predators by the respondents in the area, in which their poultry served as prey even prior to the disease outbreak. Again like the wildbirds, no samples were taken by the birdflu officials; as such no confirmation was made as to the cause of these mortalities.

Table 18 shows the estimated economic value of the wild animals that died during the avian influenza outbreak in the study area. The prices were determined locally. An equivalent sum of N107,912.5 was value of 1158 wild animals recorded while the outbreak lasted. A larger proportion (47.84%) was accounted for by *Gabella ruffrons*. While *Tadarida nigeriae* followed this, with 18.58%, *Hystrix cristate* recorded about 17.84%. The lowest percentage was observed in *Crocidura flavescens* which had 0.22%.

Table 19 indicates that lack of knowledge of biosecurity and improved poultry management practices as the foremost encountered problem with about 99.68% of the respondents showing ignorance. This implied that extension services were absolutely weak on poultry

Table 19: The major constrains to poultry production and to specifically the control of avian influenza in the study area

Constraint*	Frequency of direct respondents	Percentage of total direct respondent
Lack of knowledge Of bio-security and improved management	315	99.68
Occurrence of disease	203	64.24
Inadequacy of capital For provision of housing and equipment	299	94.62
Presence of predators	158	50.00
Insufficient marketing Outlets/poor pricing For poultry products	267	84.49
Over-stocking of poultry	148	46.84

*: Multiple responses were recorded. Source: Field Survey (2007)

production in the study area and by extension the whole state. Further supporting this finding was the confession of Mandama (2007) who stated that while the neighbouring Bauchi state was receiving about N16m for such extension work, Adamawa state's organ of such agricultural services was collecting a meager N1m (As at the time of compiling this report). Going by this revelation, the state government's effort in complementing the federal government and donor agencies programmes on containment of birdflu in Adamawa state would be lagging. Similarly, the utterance of Hunohashi (2007) that as the chairman of state publicity committee on birdflu control who had no knowledge of the activities of the state birdflu control officials clearly showed the lack of collaborative efforts within the organizational frame work of fight against this lethal disease in the state.

The above result is consistent with Ja'afar-Furo *et al.* (2007) who earlier documented majority (60.63%) of the poultry keepers in the state as having experienced lack of extension services with regard to poultry production.

Also shown in Table 19 is the inadequacy of capital for provision of good housing and poultry equipment. About 94.62% of the respondents report this constraint. Further investigation by the researchers showed that poultry farmers in the area provide dwarf-walled mud structures which were thatched as roof, with sand on floor as housing. As much as 50 birds could be kept in a 2 m diameter by 1.5 m height of such stead. Birds which could not go into such houses for whatever reason stayed on the thatch roof or walls or even trees within the household. Broken pots or scrap of dishes were positioned near the poultry houses as waterers or feeders. Sometimes gains, left-over foods etc were thrown on ground for the poultry to feed on. As proceeds from the sales of these birds were expended on family food in times of shortages, marriage ceremonies or festivities, clothing, medication and other basic family needs, virtually non would be left for construction of good houses and provision of poultry equipment.

Another constraint of prominence among the respondents was the insufficient marketing outlets and poor pricing for the poultry and poultry products. This is also indicated in Table 19. The bulk (84.49%) of the respondents encountered this problem. Most poultry and poultry products were sold to middlemen who went to these villages and bought same at cheap rates and later sold the birds at live markets in towns at exorbitant prices. Desperate need for cash and inability to withstand the rigors of shuttling between these villages and live markets in towns by the poultry farmers contributed to this problem.

Incidences of diseases were also some constraints experienced by the respondents. Majority (64.24%) of the poultry farmers who observed these problems reported that diseases of poultry that caused pockets of death existed almost on yearly basis prior to birdflu outbreak in the area. However, they had never seen massive mortalities in poultry and none even in wildlife for the over 30 years of existence of the villages in the study area. Further queries by the researchers ruled out completely the use of chemicals by the respondents which could have been toxic to the poultry and the wildlife.

The presence of predators (50.0%) and over-stocking of poultry (46.84%) were also constraints recorded in Table 19. Of the predators, domestic stray cats and dogs, wildcats, lizard buzzards and common genets were the most bothersome. Method of poultry management in the area which was like quasi-semi-intensive system which allowed ample time outdoors for free ranging by the poultry was a contributory factor. The over-stocking arose due to inadequate capital and attention towards building more spacious poultry pens for the birds. It's considered a very strong predisposing factor to disease outbreaks and was even the more reason why the avian influenza virus spread fast among the flocks of poultry in the recent outbreak in the area.

THE STUDY LIMITATIONS

Although this study was embarked upon after confirmation by the birdflu control officials of Adamawa State as areas duly infected with avian influenza virus, the officials' investigation was not comprehensive (samples of wildlife were not taken) thereby limiting this research to basically reporting the actual occurrences during the disease outbreak. Birdflu is regarded an official disease in Nigeria. Therefore, independent researchers

have limit as to what to investigate or report regarding the disease outbreak. Also inadequacy of finance hindered the authors to collect all necessary samples required for definitive diagnosis of the affected livestock and wildlife during the disease outbreak in the area for appropriate documentation.

CONCLUSIONS AND RECOMMENDATIONS

From the findings of this study, it could be concluded that the avian influenza outbreak was limited to the 6 villages and a town of the 2 LGAs in the State. Women (wives) were found to be the majority in Poultry Production in the area. The bird flu officials in the State, the body incharge of the control of the lethal virus, did not conduct a thorough investigation in the affected areas. Also, appropriate collaborative efforts of the stakeholders had not been established in the process of taking control measures. The poultry farmers were ignorant of the bird flu disease prior to the disease outbreak leading to huge economic losses both on the side of the affected farmers as well as the government for taking control measures. There was only one functional diagnostic laboratory for the lethal avian influenza virus in Nigeria at the time of this report. Finally, compensation of poultry farmers by the government and donor agencies was un-necessarily delayed.

In light of the aforementioned, the study suggests that bird flu official control team be composed of appropriate professionals (Ornithologists, Animal health workers, Agricultural economists, Information officers etc.) and other stakeholders like poultry farmers and poultry product hawkers for good synergistic effects towards massive awareness campaign. Similarly, future research team should include some female professionals so as to solve the problem of cultural factors which could impede appropriate information generation especially where women are involved. Also, more diagnostic laboratories should be opened across the length and breadth of this country in order to hasten confirmation of the samples submitted thereby reducing the cost implication on the parts of research and investigation teams. The government should always hasten the procedures of compensation of the affected poultry farmers so that the latter should promptly report new outbreak cases. Furthermore, it is strongly recommended that health status of community members of the study area be thoroughly investigated from the on-set of the avian influenza outbreak in January, 2007 and be continued monitoring closely to ascertain that no anomaly is being experienced. This stemmed from the massive consumption of moribund poultry and some infected carcasses of same reported in the area.

ACKNOWLEDGMENTS

In spite of the fact that this research was independently sponsored by the members of the team in their efforts as professionals towards providing information that could be of benefits to the government and donor agencies, we wish to thank all our organizations (Gombi Local Government Council, Ministry of Animal Health and Production and Ministry of Environment) for releasing us to conduct this study. Similarly, we are grateful to the bird flu desk office, Yola, for giving us information on the costs incurred on the part of the government for control purposes.

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