

## **Epidemiology of newcastle disease and its economic impact in chad**

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### **ABSTRACT**

*The purpose of the study has been to present the situation of Newcastle disease and to estimate the economic losses associated with mortality. A study has been conducted in 2007 in nine vets and test a vaccination campaign has been conducted in 2011 in three veterinary sectors. For the study, the choice of sectors was associated with a mission to raise awareness about avian influenza along the border west of the country. The selection of households for the study has been done randomly and availability producers. The mass vaccination campaign in related areas located nearby veterinary border regions of neighboring countries infected with avian influenza. For data collection sheets have been developed and distributed. Chickens represent 97% of the poultry. An average of 28 heads per household was volatile observed. Mortality due to Newcastle disease was 55%. It occurs throughout the year with major peaks in December and April, corresponding to periods of high concentration of poultry, the beginnings of climatic changes and the period of intensive fieldworks. The period from August to November appears as the replenishment period poultry. The duration of Newcastle disease in the herd is related to the farming system and re-infection of pets. The infection takes place in the trash and feeding areas. A series of measures of control to this disease has been proposed to limit the loss of poultry.*

**Keywords:** Epizootiology, Newcastle Disease, Rural, Poultry, Chad.

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### **INTRODUCTION**

Despite the socioeconomic importance of family poultry in Chad, diseases are an obstacle to its development. Among the diseases, Newcastle disease (ND) is a major constraint reported by industry players village poultry. ND is highly pathogenic disease, which affects all domestic and wild bird species. Among different carriers, young chickens are most susceptible, followed by turkey, quail and pheasants. Domestic ducklings seem to be resistant to Newcastle disease virus. Some of the viruses isolated from birds can infect mammals (dogs, cats, sheep, goats, pigs, horses, etc..) or men (5, 25, 27, 30, 32). ND has been diagnosed for the first time in Chad in 1954 (4). Since then, it occurs so epizootic and endemic. ND is the main cause of the loss of chickens in Africa in general and in particular in Chad. Many authors report that it is a major constraint for smallholder poultry in Chad. Each year farmers lost between 65 and 100% of unvaccinated poultry (1, 2, 3, 4, 7, 11, 13, 15, 20, 29). December and January are recognized as months where the disease is consistently (3, 21). Failure by development actors of socio-economic importance of the source of infection and spread of the virus in the household limit actions in this sector. Knowledge of the factors involved in the epidemiology of Newcastle disease is an important step forward to provide solutions.

The objective of this work is to analyze the process of emergence, maintenance and propagation of Newcastle disease in rural areas and to recommend measures to improve poultry production in Chad.

## MATERIALS AND METHODS

### 5.1 Selection site and methods of data collection

Following a mission to assess the level of biosecurity on avian influenza conducted by the team from The Ministry of Livestock and Animal Resources of republic of Chad along the western border, an epidemiological survey was conducted in April-July 2007 in nine (9) cities and their peripheries. These are: N'Djamena, the capital of the Republic of Chad, Bongor and Fianga (region of Mayo Kebbi East), Pala (Mayo Kebbi west region) Moundou (region of Logone Occidental), Baibokoum (region of Logone Oriental) and Karal (Hajar Lamis region). These cities correspond to two of three agro-ecological regions in the country. Choice of households has been done randomly and depending on the availability of producers. Survey forms have been developed on bibliographic database. Survey sites focused on the importance of the poultry, the statues of producers and the number of poultry. For the health status of poultry, the information sought have been: the period of appearance of the ND, the progress in the concession, age of affected poultry, rearing environment, etc.

### 5.2 Vaccination Campaign test

In February-April 2011 campaign "test" against ND took place in the delegations of Livestock (DL) of the Lake and Hadjer Lamis regions. The campaign covered a strip of 5 km wide (5 km by land) along the border of Lake Chad. New veterinary posts were involved in this campaign. These positions: Grédaya and Karal in the regional DL of Hadjer-Lamis; Kouloudia, Doumdoum, Isseïrom, Bol, Bagassola and Kinassarom in the Regional DL of Lake. The identification of a cord was tied to neighboring countries previously infected by HPAI in 2008.

Before starting vaccination campaign, the two delegations technicians involved Livestock activities have been trained by the Directorate of Veterinary Services (DVS). Technical materials and means of operation have been made available to teams composed of six (6) persons. Each team had 10 days to cover the area under its control. Firmware awareness has been developed and released in four languages (French, Arabic, Boudouma and Kanembu) on antennas of Office of National Radio Television (ONRTV). In addition to the release of firmware, awareness outreach was conducted before the operations, with the active support of ancillary administration (village chiefs, district chiefs, etc.). Poultry was hold mainly by women and children in a place chosen for the vaccination instead of "door to door" vaccination early in the morning and late in the evening or at night. The vaccination act was free and involved only traditional poultry, the cost of vaccination is supported by the avian influenza Project OSRO/CHD/602/EC. Vaccination has covered all chickens present in the cord. In addition to vaccination, a census of all poultry has been made and levies on domestic waterfowl made to detect the circulation of H5N1.

The first data have been collected by the heads of post in turn send them to the heads of Livestock Sector. After duplication, these informations are transmitted to the responsible of livestock Delegation for synthesis, and then to the Directorate of Veterinary Services (DVS). The results have been analyzed using methods based on epizootiological observations, historical descriptions of the disease, analyzes and comparisons.

## RESULTS

### 6.1.1. Epidemiological situation

In the courtyard of rural households chickens are ubiquitous and can be found quite often with ducks, guinea fowl and mammals such as sheep, goats, cattle, horses, pigs, dogs, cats, etc.. The herd consists of young birds and adults. The results of the study (Table I) show that the loss has varied between 26-99%. The average of mortality was 55% with a variation of 33-99% in young and 26 - 78% in adults.

Table I. Number and mortality of chickens in surveyed households during April-May 2007

Provinces	households	nuber of chikens		Total	number of dead chikens		Total	Mortality (%)		Total
		Adults	young		Adults	young		Adules	yound	
Fianga	40	651	824	1475	367	545	912	56	66	62
Léré	31	477	844	1321	123	355	478	26	42	36
Moundou	42	445	677	1122	347	668	1015	78	99	90
Baibokoum	35	419	745	1164	227	475	702	54	64	60
Bongor	47	305	645	950	99	214	313	32	33	33
Pala	62	752	1680	2432	269	598	867	36	36	36
Guelendeng	50	414	861	1275	255	677	932	62	79	73
Ndjaména	39	111	266	377	54	166	220	49	62	58
Karal	26	248	462	710	150	357	507	60	77	71
Total	372	3822	7004	10826	1891	4055	5946	49	58	55

For most households, the disease occurs spontaneously without the introduction of new subjects. The results of our observations (Table II) reveal two major periods of occurrence of Newcastle disease in both seasons Sahelian and Sudanian zones: the period from November to February and the March to June (raining season).

**Table II. Time of occurrence of Newcastle disease in 2007**

Provinces	Households	Months											
		1	2	3	4	5	6	7	8	9	10	11	12
Fianga	40	7	15	24	25	25	9	2	0	1	3	2	6
Léré	31	18	6	14	4	8	0	0	0	0	2	4	10
Moundou	42	31	11	2	2	7	2	2	4	0	3	15	37
Baibokoum	35	18	7	22	21	6	14	0	0	0	0	9	19
Bongor	47	10	0	7	35	0	0	0	0	0	0	16	30
Pala	62	12	13	17	26	9	2	2	2	4	0	19	34
Guelendeng	50	16	1	13	43	41	4	0	0	0	1	21	43
Ndjaména	39	5	1	2	1	3	3	0	1	2	0	19	22
Karal	26	6	8	12	2	0	0	2	2	0	0	2	10
Total	372	123	62	113	159	99	34	8	9	7	9	107	211

Housing is the traditional type: small chicken is unbaked brick, corner of the concession or the room, under the bed or in the shed in the yard, and in the canaries toppled from the side, etc., Subject to no decontamination. Chickens roam in the yard, around the boxes in the garbage in search of lost grain, greenery, crickets, termites, ants, insects, etc.. Producers have no knowledge about the disease and the mechanism of contamination. The remains of corpses and other volatiles are in the trash (Pictures 1 and 2), gutters and streets, around concessions, thereby fueling the chain of survival virus ND.



**Picture 1: Feathers and other bodies thrown behind the concession**



**Picture 2 : dead body thrown into the dustbin power source carnivore**

**Table III. Vaccination of chickens, 2010**

N°	DL	Sectors	Posts	1st phase of campaign			Second phase of campaign		
				V	NV	Total	V	NV	Total
01	Lac	Mandi	Bol	13388	107	13495	11872	0	11872
			Bagassola	10133	391	10524	11056	345	11401
			Kinasserom	10499	0	10499	10913	0	10913
		Wayi	Kouloudia	9639	0	9639	9791	0	9791
			Isseirome	8852	0	8852	8104	0	8104
			Doumdoum	18933	0	18933	19127	0	19127
<b>TOTAL 1</b>				<b>71444</b>	<b>498</b>	<b>71942</b>	<b>70863</b>	<b>345</b>	<b>71208</b>
02	Hadjer-Lamis	Karal	Karal	15287	637	15924	14852	347	15199
			Grédaya	10866	522	11388	15253	0	15253
<b>TOTAL 2</b>				<b>26153</b>	<b>1159</b>	<b>27312</b>	<b>30105</b>	<b>347</b>	<b>30452</b>
<b>TOTAL 1+2</b>				<b>97597</b>	<b>1657</b>	<b>99254</b>	<b>100968</b>	<b>692</b>	<b>101660</b>

NB: V = Vaccined; NV = No Vaccined

Table IV. Levies on domestic palmipeds

DL	Phases	Registered ducks and geese	Samplings	samples sent to lab	percentage of sampling	sent samples to lab
Lac	I	234	234	171	100	73
	II	116	63	0	54	0
Hadjer Lamis	I	924	837	72	91	9
	II	579	130	127	22	98
<b>Total</b>		<b>1853</b>	<b>1264</b>	<b>370</b>	<b>68</b>	<b>29</b>

Table V. Poultry survey in agricolhouseholds

Provinces	Households	Number of bird sin 2007		Avarage	
		Poultry	Chikens	Poultry	Chikens
Fianga	40	2026	1475	50,65	36,87
Léré	31	1755	1321	56,61	42,61
Moundou	42	1281	1122	30,5	22,71
Baibokoum	35	1245	1164	35,57	33,25
Bongor	47	1394	950	29,65	20,21
Pala	62	3122	2432	50,35	39,22
Guelendeng	50	1400	1275	28	25,5
<b>Total Soudanian zone</b>	<b>307</b>	<b>12 223</b>	<b>9 739</b>	<b>40,19</b>	<b>31,48</b>
N'Djaména	39	514	377	13,17	9,66
Karal	26	714	710	27,46	27,30
<b>Total Sahelian zone</b>	<b>65</b>	<b>1 228</b>	<b>1087</b>	<b>20,3</b>	<b>18,48</b>
<b>Total</b>	<b>372</b>	<b>13 451</b>	<b>10 826</b>	<b>30,25</b>	<b>24,98</b>

Table VI. Comparison of number of poultry per zone during 1995-2007

N°	Years	Regions and provinces	Average effective	Sources
1	1995	Sahelian zone	40,2	Mopaté Y. L.
2	1996	Sahelian zone	25	Mopaté Y. L.
3	2001	Sahelian zone	21,9	Rapport ONDR
4	2007	Sahelian zone	20,3	Ban-bo B. A
		<b>Average Sahelian zone</b>	<b>26,9</b>	
1	1998	Sudanian zone	22,8	Rapport ONDR
2	1999	Sudanian zone	23,9	Rapport ONDR
3	2000	Sudanian zone	28,4	Rapport ONDR
4	2007	Sudanian zone	40,2	Ban-bo B. A
		<b>Average Sudanian zone</b>	<b>28,8</b>	
		<b>National average</b>	<b>27,8</b>	

Table VII. Poultry census in 2010

DL	Phases	Chikens	Ducks	Geese	Turkeys	Pigeons	Guinea fowl	Total
Lac	Phase I	71942	234	0	291	331	0	72854
	Phase II	71208	116	0	345	969	0	72638
Hadjer Lamis	Phase I	27 312	583	341	204	531	7	28978
	Phase II	30452	372	207	147	278	10	31466

Table VIII. Epidemiological unities

N°	Regional DL	Sectors	Posts	Number of Villages Planned	villages where vaccination is carried out		Number of Households		
					Phase I	Phase II	Phase I	Phase II	Total
01	Lac	Mandi	Bol	32	26	33	396	306	702
			Bagassola	36	36	36	710	445	1155
			Kinasserom	09	12	09	183	174	357
		Wayi	Kouloudia	52	33	25	537	503	1040
			Isseïrome	23	33	34	576	429	1005
			Doumdoum	16	23	25	545	537	1082
		<b>TOTAL 1</b>		<b>168</b>	<b>163</b>	<b>162</b>	<b>2947</b>	<b>2394</b>	<b>5341</b>
02	Hadjer-Lamis	Karal	Karal	55	47	64	787	695	1482
			Grédaya	77	81	68	705	86	791
			<b>TOTAL 2</b>		<b>132</b>	<b>128</b>	<b>132</b>	<b>1492</b>	<b>781</b>
		<b>TOTAL 1+2</b>		<b>300</b>	<b>291</b>	<b>294</b>	<b>4439</b>	<b>3175</b>	<b>7614</b>

### 6.1.2. Study

Poultry producers are generally agro pastoralists, farmers, breeders large and small livestock, teachers, merchants, officials, etc.. The reason for this breeding is varied needs of small satisfaction or livestock speculative. In terms of

workforce, rural households have an average of 28 birds per farm household (Tables V, VI and VIII). This approach helped to reassess the poultry population in Chad, which is 42, 8 million in 2006. Speculating on an average price of 1500 FCFA per chicken, poultry represented a value of more than 64.2 billion FCFA in 2006. The average mortality was 55% more than 23.54 millions poultry equivalent to an annual loss of more than 35.31 billion FCFA.

## DISCUSSION

### 6.2.1. Epidemiological features

Newcastle disease has been identified for the first time in Chad in 1954. it would have come of the current Democratic Republic of Congo through Ubangi-Chari current Central African Republic). In 1968 it occurs in a very deadly in the backyard around N'Djamena (4); Mopaté *et al.* (21) found a rate of 70% in the center of the country; Maho *et al.* (3) reported 65-100% mortality in the Sudanian zone. The causes of the appearance of Newcastle disease are numerous. Breeding conditions in rural areas cause the emergence, maintenance and propagation of the virus in poultry. According to several authors, only the poultry carrier of the pathogen is responsible for the contamination by direct or indirect contact (8, 9, 12, 13, 30). Moreover, it has been reported that other poultry such as ducks, geese, pigeons, guinea fowl and other volatile wild mammals can transmit the virus Newcastle disease (5, 9, 30, 25). The interinfection and reinfection of chickens seem to be the cause of the endemic nature of this disease and its spread fast enough within households. The endemic nature of the disease in Chad explained by the fact that adult poultry, healthy carrier continues to release the virus until the appearance of more receptive young and fragile. The seasonality of Newcastle disease would be associated with periods of high concentration of birds, including young people. High mortality in young birds during the periods from November to January and March to May shows that the seasonality of MN is also linked to the reproductive cycle of poultry, confirming the source of infection is other than poultry adult, healthy carriers and other infected objects (6). According to Hanson and Makarov reported by other authors (26, 31), the high effective poultry from November and overload bins and other contact points promote the emergence and rapid spread in many households. Major peaks observed in December and April corresponding to the period of climatic changes them, cause intense works in rural areas. The first is linked to harvests and festivals year-end and the second at the beginning of field works. This leaves many authors perceive that human activities are the main cause of the emergence and spread of Newcastle disease (1, 3, 10, 17). But it remains that it is during these periods that the mobilization of cereals, other grains, their loss during transport and transformations are important. Thereby promoting contact between sick animals and healthy carriers (adult poultry and mammals) with receptive (especially young chickens), which help to accelerate the process of epizootic disease and its spread in households. In addition, a low mortality observed in the rainy season seems to be related to the partial confinement of poultry. Puddles are everywhere, grass and greenery are abundant, limiting contact between poultry where fewer outbreaks of Newcastle disease. The low mortality in the rainy season (10-15%) has been observed in Cote d'Ivoire by Danho *et al.* (28). It is strong in the dry season up to 40 - 60% according to the same authors. These rates are similar to our results (26 to 99%), those of L. Y. Mopaté and A. Maho (65-100%) observed between November and June (3, 18).

### 6.2.2. Onset period

The period from July to October appears as a lull or low infection. This is the period of restocking. This period is characterized by abundant rainfall in different regions vegetation with relatively large puddles everywhere limiting contact between animals of the same village, city or region. During the first weeks of the dry season poultry engages in hunting many insects and plant seeds around the concessions. This self-feeding activity not only promotes growth and reproduction, but also the contact between different domestic and wild animals. From November the number of young birds increases, the vegetation has declined sharply, puddles around concessions are rare. Birds meet and succeed on the garbage around concessions because food debris that producers cast. These sites appear to our opinion as places of direct or indirect contact between healthy birds receptive (especially young chickens) with patients, healthy carriers (ducks and mammals of different households) and poultry died from Newcastle disease. They promote the emergence and spread of the disease in the households. Added to this are the climatic conditions and human activity (6, 31).

### 6.2.3. Control measures

The control of this disease is difficult because the producers themselves actively contribute to the maintenance of the virus in rural areas. Garbage and other places for walking and feeding are dumps of dead birds died after diseases; farming is mixed, consisting of all species and at different ages. This explains the ignorance of the source of infection, the spontaneous appearance of the disease in the herd, its maintenance cycles between poultry production and propagation in the village or region. The mechanism of occurrence and spread in Chad, shows that it is important to develop additional issuances may improve (clean) the immediate environment (places of power and drinking interval) poultry , to conduct campaigns for mass vaccination of October and February to educate producers

on the mechanism of contamination and spread of Newcastle disease in the community. Thereby limiting poultry mortality in current poultry breeding in Chad.

#### 6.2.4. Socioeconomic importance

The survey reconsider the assessment approach of poultry, based on the rate increases. All social strata of Chad poultry raising, which is why Abba in 1997 used the rate increases to estimate the size of poultry (16). But this approach seems to have some limitations because of some rural and urban do not rise. In the family it is women and children who are involved in poultry development, but the decision to sell or slaughter for home or offer a visitor, a host usually depends on the man. Poultry is a good family oriented and rural household seems to be justified and simplifies evaluation. Chad, rural 80% of the national population, and rural households are estimated to be 1,580,235 (22, 23). The average size of 28 birds per household has been observed in 2007 and 2010 (6, 20). Although the regions do not have the same potential as poultry production and also produce urban to deal with food shortages in the cities, the difference seems negligible compensation. The average size is close to that found in Kenya (14, 19, 21, 24). These observations are now validated by the utilities and the poultry population in Chad has been revalued in 2010 to nearly 48 million heads, while it remained steady at 24 million from 1997 to 2006 (20).

During the campaign of vaccination against Newcastle disease on a cord of 5 km wide along the Lake Chad in 2010, the number of poultry census increased from 101,832 heads in the first phase to 104 104 heads in the second. Chickens represent more than 97% of the poultry and other species, including about 3% domestic waterfowl and pigeons up to 1% each. With an average price of 1500 FCFA chicken and mortality related to ND over 55%, the loss is estimated at more than 35, 31 billion FCFA. Or the third of this sum would be sufficient for large-scale systematic vaccination of poultry. Thereby limiting the loss and contribute to food self-sufficiency and the fight against poverty in rural areas.

### CONCLUSION

Poultry represents significant value for the rural and the country. Newcastle disease is a major constraint to the development of this sector, as it kills more than 55% on average poultry annually. The disease occurs throughout the year but the major peaks are observed in December and April, corresponding to a period of intensive poultry farming and climatic changes. Intra-Community trade and climatic conditions are factors favoring the occurrence of the disease, but the main cause for the occurrence of this disease remains sick animals in direct or indirect contact with receptive chickens. The duration of the disease in the herd would be related to the operating conditions and especially the mixed farming that promote infection and spread of the disease.

Vaccination against ND protects chickens. It has been real because no outbreaks have been reported in the area of the cord even if the movement of livestock observed in both phases country have influenced the relatively effective. Monitoring of domestic and wild birds, information and awareness of farmers and vaccination against ND remain the best ways to fight against the disease and to make clinical diagnosis of HPAI and other infectious diseases in the field.

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