

**Full Length Research Paper**

# Prevalence and Economic Losses from Bovine Tuberculosis in Maiduguri, Borno State, Nigeria

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## Abstract

Bovine tuberculosis (bTB) is a chronic disease that has a huge economic loss as a result of the disease burden globally. Over 50 million cattle are estimated to be infected with *M. bovis* worldwide resulting in economic loss of about 3 billion USD. The situation in Nigeria is not different as the disease is endemic in the country. Thus, this prospective study to determine the prevalence of bovine tuberculosis and the economic loss due to the disease in Maiduguri was conducted. From the prospective study conducted in the Maiduguri main abattoir, our results revealed a prevalence rate of 6.41% of organs with bTB lesions. The prevalence rate of 1.02% was obtained from slaughtered males while 8.08% of females had tuberculous lesions. A statistically significant P-Value ( $P < 0.05$ ) was obtained from the study indicating that female cattle are more prone to bTB than males. Furthermore, the study revealed a direct loss (DL) of ₦4,841,879.2 (\$24,209,396 USD) based on the condemnation of organs, an indirect loss (IL) of ₦344,738,320.69 (\$1,723,691.6 USD) which when combined gave us an annual loss (AL) of ₦349,580,199.89 (\$1,747,901 USD). This indicates that bTB in Maiduguri is not just a threat to the economy of the livestock industry but also to food security, food safety and the health of the public. Hence, the need to take precautionary measures by the government and stake holders to avert the menace of the disease.

**Key Words:** Bovine Tuberculosis, Abattoir, Prevalence, Direct and Indirect Economic Loss, Annual Loss.

## Introduction

Bovine tuberculosis in Nigeria is a disease that has substantive economic losses due to its endemicity in the country. Beef cattle trade provides one of the largest livestock market in the country. Millions of Nigerians made their livelihood from the beef enterprises as producers, marketers and transporters. Others serve as processors of beef products, feed millers and provision of Veterinary Services. It also generates a lot of revenue to the government through various forms of taxations (Umar *et al.*, 2008). In spite of all the contributions, the livestock sub-sector is a relatively neglected part of agriculture with its supporting services collapsing well ahead of others (Oni, 2006). Although Nigeria plays a vital role in the livestock economy of Africa, her livestock production is not enough to meet the domestic protein needs. The total supply of livestock products fall short of the overall demand. In some cases, the domestic production and noted importations are together still not enough to meet more than 60% of the actual demand (Mbanasor, 2000).

Bovine tuberculosis is an endemic disease of cattle in Nigeria which affects food safety, food security, international trade and consequently a means to public health hazard. In Nigeria, bTB is a disease whose impact is grossly underestimated and its effect on the economy. Currently, there are a lot of lapses in our production system; passive surveillance of the disease is rarely adhered to because of lack of compensation to the affected livestock owners thereby sometimes resulting in the selling of infected tissues and organs. Active surveillance of the disease is hardly conducted either by the government or the livestock farmers. Within the various regions of the country, there is no movement restriction of livestock and the porosity of our international borders which promotes the influx of cattle across our borders also promotes the persistence of the disease.

To this end, the determination of direct and indirect losses and the annual loss in the Maiduguri Main abattoir was carried out in order to create a visible picture of the losses encountered due to bTB. This study is the first of its kind in Maiduguri area of Borno state with large concentration of livestock. The authors are of the view that the data presented here will further emphasize the importance of this disease in our cattle.

## Materials and Methods

This prospective study was carried out from July to September 2013 (within a span of 3 months). The prevalence study was carried out based on the number of cattle with tuberculous lesions and the total number of cattle slaughtered within the period of study (selected days which the lesions were collected). The formula of Thrusfield (1997) was used in calculating the prevalence;

$$\begin{aligned} \text{Prevalence} &= \frac{\text{Number of individuals having a disease at a particular point in time}}{\text{Number of individuals in the population at risk at that point in time}} \\ &= \frac{\text{Number of positive cattle} \times 100}{\text{Total number of cattle slaughtered}} \end{aligned}$$

SPSS version 16.0 was used in calculating the chi square ( $X^2$ ) value and the P-Value for this study.

The average cost of edible organs (lungs, heart, liver, kidney and spleen) was obtained through oral interviews with the butchers and meat sellers at the abattoir. The formula of Ogurinate and Ogurinate (1980) as indicated by Guadu *et al.*, (2013) was used in the calculation of the direct and indirect losses as well as the total annual loss due to bTB.

Direct Loss (DL) = (MAS x PLu x CLu) + (MAS x PLi x CLi) + (MAS x PHr x CHR) + (MAS x PKi x CKi) + (MAS x PSp x CSp). where; MAS = Mean annual cattle slaughtered at study abattoir; PLu = Percentage of lung condemned; CLu = Mean cost of a lung; PLi = Percentage of liver condemned; CLi = Mean cost of a liver; PHr = Percentage of heart condemned; CHR = Mean cost of a heart; PKi = Percentage of kidney condemned; CKi = Mean cost of a kidney; PSp = percentage of spleen condemned; CSp = mean cost of spleen. MAS was estimated to be 54,750 based on average daily slaughter of 150 x 365 days of the year based on observation during the prospective study, because of lack of documented data on annual slaughter rate in the abattoir.

$$\text{The percentage of infected organ} = \frac{\text{infected organ}}{\text{Total no. of organs}} \times 100$$

Indirect Loss (IL) = MAS x CL x BC x P, IL = MAS x (292.3KG x 33.6%) x BC x P. Where; MAS = mean annual cattle slaughtered at study abattoir; CL = percentage of carcass weight reduction; BC = average price of 1kg beef in Maiduguri city butcheries; P = prevalence rate of bovine tuberculosis at study abattoir (6.41%). An average carcass weight of cattle in Bama Local government area of Borno state was estimated at 292.3kg based on the study of Umar *et al.*, (2008), this weight was used in the calculation of indirect loss since the study was carried out in Borno.

$$\%WL (\text{Average}) = \frac{\%WLAH \times N0 \text{ of AH Animals} + \%WLSE \times N0 \text{ of SE Animals} + \%WLE \times N0 \text{ of E Animals}}{\text{Total NQ of infected animals (160)}}$$

Where %WL = Percentage Weight Loss; AH = Apparently Healthy; SE = Slightly Emaciated; E = Emaciated. Assuming %WLAH = 5%; %WLSE = 10% and %WLE = 40%. The %WL calculated = 33.6%

The total annual economic loss was determined using the formula "Total Annual Economic Loss = (DL+IL)". The calculation was done in Naira (₦) and converted to United States Dollars (\$) at a conversion rate of ₦200 to a dollar.

## Results

Tuberculous lesions were collected from cattle over a period of 3 months; the number of cattle slaughtered for each day that the lesions were collected was recorded. A total of 2,495 cattle were slaughtered in the Maiduguri main abattoir based on the days that the lesions were collected. Five hundred and eighty eight (588) were males and 1,907 were females. A total of 160 cattle were found with tuberculous lesions of various degrees. Out of the 160 cattle with tuberculous lesions, 6 were males and the remaining 154 were females. Grading by the data obtained, 24% of the cattle slaughtered in the Maiduguri abattoir during the period of the study were males whereas 76% of the slaughtered animals were females. The prevalence of 6.41% (males and females combined) of bTB-like lesions was found within this period. 1.02% of the slaughtered males turned out to have tuberculous lesions and 8.08% of the females slaughtered had tuberculous lesions. No tuberculous lesions were found in slaughtered calves from the age of one and below. There was a significant P-value (0.000) indicating that females are more prone to bTB than males (Table 1 and Fig. 1. below). Our data also revealed that out of the 160 cattle with tuberculous lesions in various organs; 14 of them were looking apparently healthy, 18 were slightly emaciated and 128 of them were emaciated.

Table 2 and Fig. 2 below indicates tuberculosis organs with their percentages; lungs (72.4%), heart (11.5%), spleen (2.8%), liver (9.2%) and kidney (4.1%) plus the average market price of healthy lung, liver, heart, kidney and spleen are (₦1000, ₦2000, ₦700, ₦500 and ₦300) respectively. The direct loss (DL) calculated from this study amounted to ₦4,841,879.2 (\$24,209.396 USD) whereas the indirect loss (IL) amounted to ₦344,738,320.69 (\$1,723,691.6 USD). Meanwhile, the total annual economic loss (DL+IL) amounted to ₦349,580,199.89 (\$1,747,901 USD).

Table 1: Prevalence of bTB in the Maiduguri main abattoir

Sex	Positive	Negative	Total	X <sup>2</sup>	P-Value	Prevalence (%)
Female	154	1753	1907	37.273	0.000	8.08
Male	6	582	588			1.02
Total	160	2335	2495			6.41

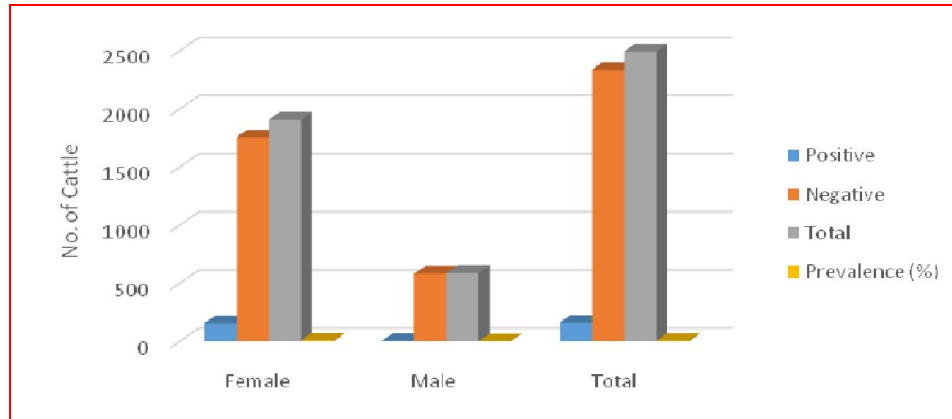


Fig. 1: Showing the positive cattle, negative, total and prevalence

Table 2: Analysis of organs with tuberculous lesions

S. No	Organs/parts affected	Frequency	Percentages (%) of condemned organs	Average price of organs at Maiduguri market (Naira)
1.	Lungs	157	6.29 (157/2495)	1000
2.	Heart	25	1.00 (25/2495)	700
3.	Spleen	6	0.24 (6/2495)	300
4.	Liver	20	0.80 (20/2495)	2000
5.	Kidney	9	0.36 (9/2495)	500

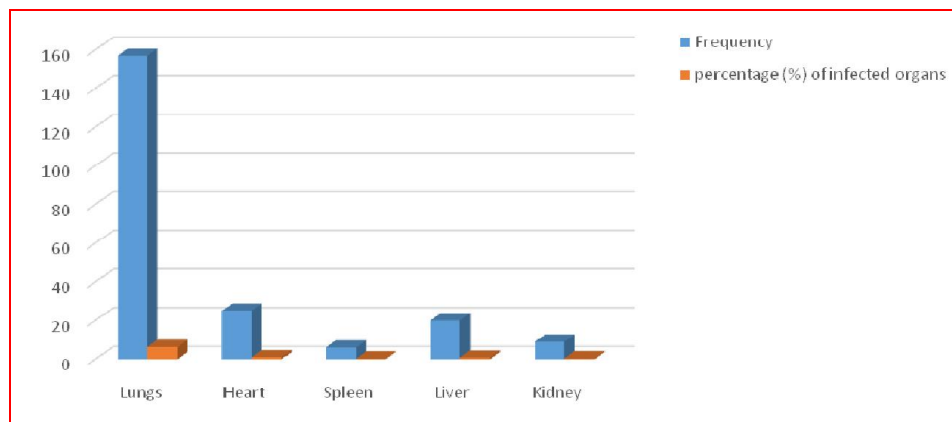


Fig. 2: Showing frequency and percentage of organs with tuberculous lesions.

**Discussion**

From the prospective study conducted, our results revealed overall prevalence of 6.41%. The prevalence rate of 1.02% was obtained from slaughtered males while 8.08% of females had tuberculous lesions. Our study also concurs with that of Cadmus *et al.* (2006) in south-western Nigeria who reported a prevalence rate of 8.8% and that of Ejeh (2014c) who reported a prevalence of 10.7% in Benue state, Nigeria. In a retrospective study (2008-2012) carried out by Ejeh *et al.* (2013) in Yola, Northeast region of Nigeria indicated an overall prevalence of 8.68% of bTB based on a retrospective study. This also tallies with the retrospective study of Danbirni *et al.*, (2013), where the prevalence of bTB in Adamawa state was 6.7%. The study does not agree with the report of Opara *et al.*, (2012) who reported a prevalence of 3.4% in their study conducted in Imo state, southeastern Nigeria. Our study was not in agreement with the studies of Nwata *et al.* (2008) in Enugu, South-eastern Nigeria 1.4%, Raufuand Ameh (2010) with a prevalence rate of 1.1% in

Maiduguri, Northeastern Nigeria, which is much lower than what we obtained. This study also does not tally with report of Cadmus *et al.* (2010), who reported 0.41% at Oko-Oba abattoir in Lagos state. Since ours is a prospective study, it is suggestive that the results of the above retrospective studies may be due to inadequate antemortem and postmortem inspections. Due to the issue of lack of compensation of condemned carcasses, Veterinarians and other meat inspectors are no longer able to condemn whole carcasses that are infected. Secondly, some of the infected organs are normally hidden by the butchers after opening up the carcass which are later on sold to the public who are mostly ignorant of the hazard associated with consuming infected organs. Thirdly, the strict keeping of records of infected carcasses is not duly adhered to leading to under-reporting of the disease in the record of our abattoirs. Another factor that may be responsible for the disparity in the prevalence rates between our study and that of Nwata *et al.* (2008) and Cadmus *et al.* 2010, may be due to the sources of the animals. These studies were conducted in the Eastern and Western part of the country respectively. Normally, cattle that are taken to the Eastern or Western part of the country from the Northern states (being the major producers of cattle in the country) are usually healthy or those that look apparently healthy due to the long distance travel bearing in mind that sick animals may not be able to withstand the stress of the journey. Whereas in states like Borno which is one of the major cattle producing states in the country which shares borders with Niger and Chad in the North, and Cameroun on the Eastern region with no border restriction to the influx of trade cattle. Also Damboa Local Government Area, where most of the cattle slaughtered in the Maiduguri main abattoir came from, had a very high prevalence rate (20%) of bTB as reported by Igbokwe *et al.* 2001. Furthermore, sick and cachexic looking animals are often brought to the abattoir for slaughter. This study has shown that female cattle had more prevalence rate of tuberculous lesions than males and the difference was statistically significant ( $P < 0.05$ ) which tallies with earlier reports.

This study has revealed a direct loss (DL) of ₦4,841,879.2 (\$24,209.396 USD) based on the condemnation of organs in the Maiduguri main abattoir, an indirect loss (IL) of ₦344,738,320.69 (\$1,723,691.6 USD) which when combined gives us an annual loss (AL) of ₦349,580,199.89 (\$1,747,901 USD). This indicates that a lot of losses are encountered due to bTB in cattle in Maiduguri and not only a treat to the zoonotic aspect but also to the economy in terms of international trade, food safety, food security which further emphasize the socio-economic importance of the disease. Similar study was conducted by Adedipe, (2014), who calculated the direct and indirect losses of infected organs from Bodija abattoir in Ibadan and found losses of ₦187,678,920 (\$1,251,192.8) and ₦315,242,928 (\$2,101,619.52) respectively with an annual economic loss of ₦509,921,848 (\$3,352,812.32) at a conversion rate of ₦150 to a dollar (USD). Also, ₦2,910,000 (\$18,200 USD), were condemned within the study period accounting for the economic losses due to condemnation of edible organs (Ejehet *et al.* 2014b). In Nigeria, about 36% of meat supply comes from beef alone, as reported by Aniebo *et al.* 2009 and an annual loss of 5 million United States dollars in meat products has been reported (Garba *et al.* 2002).

Economic losses due to bTB in Mejía canton, Ecuador are estimated at approximately 460,000 USD per year (CITT) (Anonymous, 2000) whereas a study conducted in Ethiopia revealed that out of 1.2 million slaughtered cattle in eight export abattoirs, there was an estimated cost of more than 600,000 ETB (300,000 USD) loss during a respective time, due to condemned carcasses and organs (Gezahegne, 1991).

### Conclusion and Recommendation

In conclusion, this study has shown a prevalence of 6.41% in terms of TB lesions detected. The study has shown that TB lesions are significantly higher in female cattle compared to males. The direct and indirect losses were enormous and could be a treat to the livestock industry. It is therefore recommended that measures aimed at reduction in the number of cases be instituted in various herds to prevent the occurrence of bTB. Strict enforcement of quarantine services at the international borders to prevent entry of sick animals.

### Acknowledgement

Our gratitude's goes to the staff of the Maiduguri abattoir who gave their full cooperation.

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