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# Prevalence, Risk Factors and Economic Losses Associated with Fasciolosis in Slaughtered Cattle in Bauchi, North-Eastern Nigeria

**[1]Karshima N.S., [2]Bata S.I., [3]Bobbo A.A.**
[1]Department of Veterinary Public Health and Preventive Medicine, University of Jos, PMB 2084, Jos, Nigeria, [2]Department of Animal Health, Federal College of Animal Health and Production Technology, PMB 001, Vom, Nigeria, [3]Department of Animal Health, College of Agriculture Jalingo, PMB 1025,Jalingo, Taraba State, Nigeria.

## ABSTRACT

Fasciolosis is a snail-borne parasitosis of veterinary, medical and economic importance with a worldwide distribution. In this study, we determined the prevalence, risk factors and economic losses associated with the disease in slaughtered cattle in Bauchi, Nigeria using macroscopic examination at the abattoir, simple sedimentation technique and close ended structured questionnaires. We analysed our data using Chi square, Odds ratio and logistic regression at 95% confidence interval. Of the 208 samples analysed, we observed an overall prevalence of 29.8% (62/208) which varied significantly ($p < 0.05$) between Red Bororo (18.8%) and White Fulani (34.7%). Prevalence rates in relation to sex, management practices and body conditions varied significantly ($p < 0.05$) ranging between 10.9% and 90.0%. Based on sources of cattle, fasciolosis recorded highest (84.2%) and lowest (6.7%) prevalence rates in Tafawa Balewa and Bogoro respectively. A total of 312.6 kg of liver estimated at a cost of # 312,600 (1,570.9 USD) was condemned as a result of fasciolosis during our study. Approximate annual losses of liver due to this disease were estimated at 3751.2kg at a total cost of #3,751,200 (18,850.3 USD). Grazing animals in swampy areas, presence of snails around grazing sites, watering animals using streams, extensive management and lack of routine de-worming all influenced the prevalence of bovine fasciolosis in Bauchi. Fasciolosis remains prevalent and is associated with considerable economic losses in cattle slaughtered in Bauchi, Nigeria. An effective control of the disease requires improvement of management practices and routine de-worming.

**Key words:** Prevalence, risk factors, economic losses, fasciolosis, parasitic zoonosis, slaughtered cattle

**Corresponding Author:**Solomon N. Karshima, torkarshima@yahoo.co.uk

## 1. INTRODUCTION

*Fasciola* refers to a genus of economically important snail-borne parasitic trematodes of the sub-class digenea, class trematoda and phylum platyhelminthes. They infect the liver of various mammals including man causing a parasitic zoonosis called fasciolosis; a disease classified among neglected tropical diseases. Two species of veterinary and medical importance are *Fasciola hepatica* and *F. gigantica*. While *F. hepatica* has a worldwide distribution with preference for temperate regions, *F. gigantic* is primarily found in tropical and sub-tropical areas (Young et al., 2011).

Life cycle of *Fasciola* species is indirect requiring snails of the family lymnaeidae as intermediate hosts. The abundance and activity of these intermediate hosts is influenced by environmental conditions including temperature, rainfall and soil moisture (Issia et al., 2009; Alasaad et al., 2011). The life cycle involves five developmental stages namely: miracidia, sporocysts, rediae, cercariae and metacercariae which is usually the stage infective to the definitive host.

It was estimated that *Fasciola hepatica* and *Fasciola gigantica* infect at least 2.4 million people in more than 70 countries worldwide exempting no continent (Furst et al., 2012). Naturally, transmission to animals and man requires the role of snail intermediate host where the parasitic larvae develops to infective metacercaria which is latter attached to pasture infecting grazing animals and humans that feeds on vegetables (Furst et al., 2012). Accidental human infection resulting from ingestion of eggs on contaminated vegetables has been documented (Biu et al., 2006). Infection rates of up to 90% have been documented among various animals including sheep, goats, cattle, buffalo, horses, donkeys, camels and rabbits (WHO, 2007).

Fasciolosis is endemic in Nigeria and is of great economic importance especially in Northern Nigeria where stagnant waters and Fadamas are used as watering and grazing sites during the dry season.

*Fasciola hepatica* infects more than 300 million cattle and 250 million sheep worldwide and together with *Fasciola gigantica*, cause significant economic losses to global livestock industry estimated at over USD 36 million annually through lost in productivity (Mas-coma et al., 2005). Majority of studies on fasciolosis targeted prevalence without considering other factors associated with its occurrence. In order to bridge this gap, we designed this study to determine the prevalence, risk factors and economic losses associated with the disease in Bauchi, Nigeria.

## 2.Materials and Methods

### 2.1. Study area

This study was carried out in Bauchi abattoir and meat factory both located in Bauchi, the capital city of Bauchi State. The 208 slaughtered cattle originated from 15 Local Government Areas of the State namely; Alkaleri, Bauchi, Bogoro, Dass, Dambam, Darazo, Ganjuwa, Katagun, Kirfi, Misau, Ningi, Shira, Tafawa Balewa (T/Balewa), Toro and Warji. Bauchi State is located in North-eastern Nigeria between latitudes 9°30′ and 12°30′N and longitudes 8°50′ and 11°00′E covering a total land mass of 49,119 square kilometres. It consists of two distinct vegetations namely; Sudan Savannah to the south with annual average precipitation of 1,300 mm (April-October) and Sahel Savannah to the west and north with annual average precipitation of 700 mm (June-October). The State has average daily maximum temperatures ranging from 29.2°C (July-August) to 37.6°C (March-April) while the mean daily minimum temperatures range from about 11.7°C (December-January) to 24.7°C (April-May). Humidity ranges from about 12% in February to about 68% in August. The State is watered by several water sources including rivers Jama'are and Gongola, Maladumba Lake, Balanga dam and various Fadamas.

### 2.2. Study design

We conducted an abattoir-based randomised cross sectional study in Bauchi. A total of 208 bile samples were collected from slaughtered cattle between October, 2015 and February, 2016 using systematic sampling technique. Every $10^{th}$ cattle presented for slaughter at the Bauchi abattoir and meat factory were sampled following the order to which the cattle were moved from the lairage to the slaughter hall. We sampled a maximum of 20 cattle during each abattoir visit, 10 each from the abattoir and meat factory. Of the 208 cattle sampled, 100 farmers who presented their cattle for slaughter and whose cattle were included in the study were given well structured close ended questionnaires to assess risk factors. Both prevalence and risk factors were estimated at 95% confidence interval.

### 2.3. Sample collection and questionnaire administration

Gall bladder of each slaughtered cattle included in the study was collected following slaughter and evisceration in a well labelled polythene bag and transported in cooled flask to the Parasitology Laboratory of the National Veterinary Research Institute Vom, Nigeria for parasitological analysis. Well structured close ended questionnaires were administered to 100 volunteered farmers who presented their cattle for slaughter and who were willing to provide information on the kind of management practices observed on their farms. Logistic regression was employed to determine statistical association between risk factors such as grazing cattle around swampy areas, presence of snails around grazing sites, watering cattle in streams, extensive management of cattle and lack of routine de-worming and the prevalence of fasciolosis in cattle slaughtered in Bauchi abattoir and meat factory.

### 2.4. Laboratory analysis and estimation of economic losses

Each gall bladder was opened and the entire content washed in to a beaker, centrifuged at 1000 rpm for 5 minutes and analysed using simple sedimentation technique as described by Zajac, (2006). The eggs of *Fasciola* species were identified using morphological characteristics as earlier described (Soulsby, 1982; Zajac, 2006).

Slaughtered cattle were inspected for the presence of fasciolosis and judgement was based on the extent of liver damage as partial or total condemnation. We estimated total weight in kilogram of livers condemned as a result of this disease for 30 days and multiply by the number of months in a year to determine approximate annual losses of liver tissue in kilogram. This value was then multiplied by the average current market price per kilogram of liver in Bauchi in Naira and USD at current exchange rate to determine financial losses caused by the disease.

### 2.5. Data analysis

All data generated were analysed using Statistical Package for Social Sciences (SPSS Version 20.0) and Graph Pad Prism 4.0. Prevalence rates were calculated by multiplying the ratio of number of cattle infected with fasciolosis and total number of cattle examined by 100. This was done for variables such as sex, management practices,

body condition and source of animals. The Chi square test, Odds ratio and logistic regression were employed to check for statistical association between the prevalence rates and risk factors of these infections and values of $p < 0.05$ were considered significant.

## 3.RESULTS

Of the 208 samples analysed, we observed an overall prevalence of 29.8% (62/208) which varied significantly ($p = 0.0201$, $\chi^2 = 5.402$, OR = 0.4338, 95% CI = 0.2121-0.8873) between Red Bororo (18.8%) and White Fulani (34.7%). Prevalence of fasciolosis in relation to sex also varied significantly ($p = 0.0034$, $\chi^2 = 8.579$, OR = 2.498, 95% CI = 1.342-4.648) between females (43.3%) and males (23.4%) as shown in Table 1.

There was also significant variation ($p = 0.0286$, $\chi^2 = 4.793$) between the prevalence rates of 35.4%, 21.4% and 18.2% revealed by extensively, semi-intensively and intensively managed cattle (Table2). Prevalence rates in relation to body conditions of slaughtered cattle showed very high statistical association ($p < 0.0001$, $\chi^2 = 62.45$) with values of 10.9%, 44.9% and 90.0% for cattle with good, moderate and poor body conditions respectively (Table 3).

The distribution of fasciolosis across LGAs where slaughtered cattle originated was highest in Tafawa Balewa (84.2%) and lowest in Bogoro (6.7%). Zero prevalence rates were observed for both Shira and Warji LGAs. Others include: Bauchi (26.9%), Dass (7.1%), Dambam and Kirfi (18.8%), Darazo (35.3%), Ganjuwa (14.3%), Katagum (29.4%), Misau and Ningi (20.0%) as well as Toro (38.9%) as in Figure 1. A total of 312.6 Kg of liver at an estimated cost of # 312,600 (1,570.9 USD) was condemned as a result of fasciolosis during our study. Approximate annual losses of liver due to this disease were estimated at 3751.2kg at a total cost of #3,751,200 (18,850.3 USD) as in Table 4.

Risk factors such as grazing animals in swampy areas ($p = 0.0437$, OR = 1.810, 95% CI = 1.012-3.238), presence of snails around grazing sites ($p < 0.0001$, OR = 0.2092, 95% CI = 0.1253-0.3490), watering animals using streams ($p < 0.0001$, OR = 0.1268, 95% CI = 0.07300-0.2204), extensive management ($p < 0.0001$, OR = 0.1129, 95% CI = 0.06412-0.1987) and lack of routine de-worming were all associated with the prevalence of fasciolosis in slaughtered cattle in Bauchi (Table 5).

**Table 1:** Breed and sex based prevalence of fasciolosis in cattle slaughtered in Bauchi.

| Breed | Number examined | Number positive | Prevalence (%) | p-value ($\chi^2$) | Odds ratio (95% CI) |
|---|---|---|---|---|---|
| Red Bororo | 64 | 12 | 18.8 | 0.0201 | 0.4338 |
| White Fulani | 144 | 50 | 34.7 | (5.402) | (0.2121-0.8873) |
| **Total** | **208** | **62** | **29.8** | - | - |
| | | | | | |
| **SEX** | | | | | |
| Females | 67 | 29 | 43.3 | 0.0034 | 2.498 |
| Males | 141 | 33 | 23.4 | 8.579 | (1.342-4.648) |
| **Total** | **208** | **62** | **29.8** | - | - |

**Table 2:** Prevalence of fasciolosis in slaughtered cattle in relation to management practices.

| Management practices | Number examined | Number positive | Prevalence (%) |
|---|---|---|---|
| Extensive | 130 | 46 | 35.4 |
| Semi-intensive | 56 | 12 | 21.4 |
| Intensive | 22 | 4 | 18.2 |
| **Total** | **208** | **62** | **29.8** |
| $\chi^2$ | - | - | 5.233 |
| P-value | - | - | 0.0286 |

**Table 3:** Prevalence of fasciolosis in slaughtered cattle in relation to body conditions.

| Body condition | Number examined | Number positive | Prevalence (%) |
|---|---|---|---|
| Good | 119 | 13 | 10.9 |
| Moderate | 69 | 31 | 44.9 |
| Poor | 20 | 18 | 90.0 |
| **Total** | **208** | **62** | **29.8** |
| $\chi^2$ | - | - | 62.45 |
| P-value | - | - | <0.0001 |

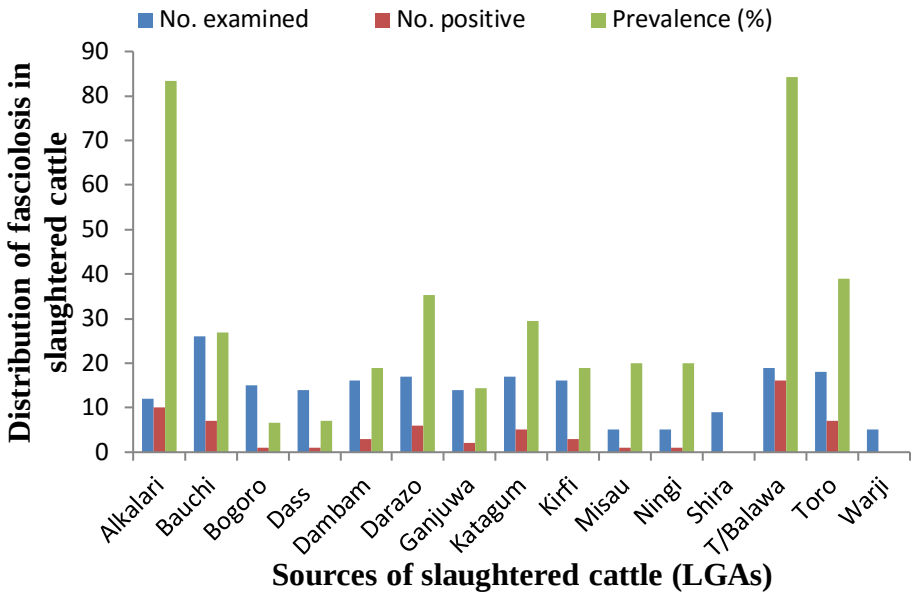


**Figure 1:** Distribution of fasciolosis in relation to sources of slaughtered cattle

**Table 4:** Economic losses associated with fasciolosis in cattle slaughtered in Bauchi.

| Variables | 30 days losses (Kg) | Estimated annual losses (Kg) | 30 days Financial losses in Naira (USD) | Estimated annual financial losses in Naira (USD) |
|---|---|---|---|---|
| **SEX** | | | | |
| Females | 189.2 | 2270.4 | 189,200 (950.8) | 2,270,400 (11,409.1) |
| Males | 123.4 | 1480.8 | 123,400 (620.1) | 1,480,800 (7,441.2) |
| **Total** | **312.6** | **3751.2** | **312,600 (1570.9)** | **3,751,200 (18,850.3)** |
| **BREED** | | | | |
| Red Bororo | 101.1 | 1213.2 | 101,100 (508.0) | 1,213,200 (6,096.5) |
| White Fulani | 211.5 | 2538.0 | 211,500 (1062.8) | 2,538,000 (12,753.8) |
| **Total** | **312.6** | **3551.2** | **312,600 (1570.9)** | **3,751,200 (18,850.3)** |

**Table 5:** Analysis of risk factors for fasciolosis in cattle slaughtered in Bauchi.

| Variable | Variable type | NQA | TR | NR | P-value | Odds ratio (95% CI) |
|---|---|---|---|---|---|---|
| Grazing around swampy areas | Predictor variable | 100 | Yes<br>No | 81<br>19 | 0.0437 | 1.810<br>(1.012; 3.238) |
| Presence of snails in grazing sites | Predictor variable | 100 | Yes<br>No | 67<br>33 | <0.0001 | 0.2092<br>(0.1253; 0.3490) |
| Watering animals in streams | Predictor variable | 100 | Yes<br>No | 77<br>23 | <0.0001 | 0.1268<br>(0.07300; 0.2204) |
| Extensive Management | Predictor variable | 100 | Yes<br>No | 79<br>21 | <0.0001 | 0.1129<br>(0.06412; 0.1987) |
| Lack of routine de-worming | Predictor variable | 100 | Yes<br>No | 60<br>40 | <0.0001 | 0.2831<br>(0.1720; 0.4660) |

NQA (Number of questionnaires administered), TR (Type of response), NR (Number of respondents)

## 4. DISCUSSION

Fasciolosis is a disease of veterinary, medical and economic importance worldwide. Our finding has shown that this neglected tropical disease is prevalent in Bauchi, Nigeria. The occurrence of fasciolosis in this study area confirms the presence of snail intermediate host in this region. In this abattoir-based study, we sampled more of bulls than cows based on their availabilities. The fewer cows slaughtered may not be unconnected with the fact that they are always retained on farms for the purpose of breeding. Although several workers used faecal samples to analyse for the presence of *Fasciola* eggs (Ademola et al.,2003; Kamani et al.,2007; Tung et al., 2012; Squire et al., 2013), our choice of bile for this study is because of the high concentration of eggs of these parasites in gall bladder (Osmana et al., 1998; Sakamoto and Oikawa, 2007).

The overall prevalence of 29.8% observed by our study is lower than reports documented over three decades ago in Nigeria (Schillhorn et al., 1980; Nwosu and Srivastava, 1993). This finding is however within the range of 21.8%-30.02% documented in recent studies in Nigeria and elsewhere (Ardo et al., 2013; Magaji et al., 2014; Asmare and Samuel, 2015). This suggests possible decline in the prevalence of the disease in recent years probably due to a better understanding of the epidemiology of the disease and success in existing control strategies which may include improved management practices and routine control programmes. Other factors that might have influenced these variations may include differences in sample types collected for the various studies, differences in vegetation, types of tests used by the various studies and the abundance of the snail intermediate hosts which are required for the completion of *Fasciola* life cycle.

We observed a significantly higher prevalence in females than males in line with the reports of Biu et al. (2006) and Aliyu et al. (2014) but contrary to the report of Jegede et al. (2015). The higher prevalence recorded by females may be due to stress associated with hormonal imbalances during pregnancy in female animals which usually increase their susceptibility to infections. The fact that cows are normally kept longer in herds for the purpose of breeding may also explain the higher prevalence observed among this group since fasciolosis usually manifest as a chronic disease. The higher prevalence observed by the White Fulani breed of cattle may not be unconnected with their predominantly higher representation in the sample size. The nomadic system of management usually practiced by owners of White Fulani breeds may be another possible explanation for the higher prevalence rate among this group.

Free grazing pastures are usually contaminated by grazing animals thus increasing the risk of infection in extensively managed animals especially where the snail intermediate hosts are in abundance. This may be a possible reason for the higher prevalence we observed among extensively managed cattle. Fasciolosis is also known to be associated with weight loss (Maingi and Mathenge, 1995; Wamae et al., 1998). It was therefore not unexpected to have observed the highest prevalence among cattle with poor body condition. This weight loss also contributes to total economic losses associated with this disease.

Cattle slaughtered in Bauchi during this study were sourced from 15 Local Government Areas (LGAs) of the State. Grazing poor wet pasture usually increase the risk of fasciolosis and so the presence of rivers Jama'are and Gongola, Maladumba Lake, Balanga dam and various Fadamas traversing Tafawa Balewa and Alkaleri may be the possible reasons for the higher prevalence of fasciolosis in these two LGAs. The presence of various wildlife species which are natural reservoirs of *Fasciola* species in the Yankari game reserve located in Alkaleri LGA may be an additional reason for the higher prevalence rate observed in this area.

Financial losses associated with fasciolosis in the study area during 30 days were estimated at #312,600 (1,570.9 USD). This is considerably high considering the time span of the study and the facts that this study was carried out in only one urban area and for only one disease. We used the findings of the 30 days study to extrapolate the approximate annual financial losses caused by fasciolosis which was estimated at #3,751,200 (18,850.3 USD). Our finding is slightly lower than the report of Danbirni et al. (2015) in Kano, Nigeria and Mousa et al. (2013) in Sudan suggesting decline in the prevalence and severity of fasciolosis in Nigeria probably due to effective control programmes against the disease. This finding is however higher than the report from Egypt (Elmonir et al., 2015). The implication of our finding is that, the control of fasciolosis in only one urban settlement in Nigeria will save approximately #3,751,200 (18,850.3 USD) per annum and thus increase the gross domestic product of Nigeria.

We found the risk of acquiring fasciolosis to be 1.810 times higher when animals are grazed in wet and swampy areas. This finding was not surprising because of snails' preference for swampy areas. Presence of snails in grazing sites, watering animals using streams were other risk factors that influenced

the prevalence of fasciolosis in the study area. These findings were also not unexpected since snail intermediate hosts are necessary for the completion of *Fasciola* life cycle. Extensive management as well as lack of routine de-worming also influenced the risk of fasciolosis about 0.1129 and 0.2831 times respectively. This implies that improving management practices and strategic de-worming programmes will help in the control of this parasitic zoonosis in the region.

## 4.CONCLUSION

Fasciolosis remains prevalent in cattle in Bauchi, Nigeria and is distributed across different LGAs of the State. The disease is associated with considerable economic losses in cattle as a result of condemnation of edible liver tissues. The risk of fasciolosis is influenced by grazing animals in swampy areas, availability of snail intermediate hosts around grazing sites, watering animals using streams, extensive management and lack of routine de-worming. Effective control of the disease therefore requires improvement of management practices and routine de-worming of animals, which will in turn add to the gross domestic product of Nigeria.

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