

RESEARCH PAPER**OPEN ACCESS****Prevalence, risk factors, and economic impact of *Fasciola gigantica* infection among slaughtered carabaos (*Bubalus bubalis*) in the Municipality of Baggao, Cagayan, Philippines****John Michael U. Tabil*, Jhaysel G. Rumbaoa***College of Veterinary Medicine, Cagayan State University, Carig Sur, Tuguegarao City, Cagayan, Philippines***Key words:** *Fasciola gigantica*, Fasciolosis, *Bubalus bubalis*, Carabao, Prevalence, Postmortem examination, Liver condemnation, Economic loss**Received:** 22 June, 2026**Accepted:** 02 July, 2026**Published:** 09 July, 2026**DOI:** <https://dx.doi.org/10.12692/jbes/29.1.55-63>**ABSTRACT**

Fasciola gigantica infection remains one of the most economically important parasitic diseases affecting carabaos (*Bubalus bubalis*) in the Philippines, resulting in liver condemnation and substantial financial losses in the livestock industry. This study determined the prevalence of *F. gigantica* infection in slaughtered carabaos through postmortem liver examination and estimated the direct economic losses associated with liver condemnation in the Municipality of Baggao, Cagayan, Philippines. A cross-sectional abattoir survey was conducted over a one-month period involving 31 slaughtered carabaos subjected to routine meat inspection. Liver samples were examined macroscopically for the presence of adult *F. gigantica*, while data on sex, breed, and age were recorded. The overall prevalence of liver fluke infection was 48.39% (15/31). Male carabaos exhibited a higher prevalence (52.63%) than females (41.67%). Native carabaos showed a prevalence of 51.72%, whereas no infections were detected among the two Murrah animals examined. Age-specific analysis revealed the highest prevalence among animals aged 1–3 years (77.78%), followed by those aged 4–5 years (44.44%) and 6–10 years (30.77%), indicating greater susceptibility among younger animals. The 15 infected livers weighed a combined 79.6 kg, and with an average market value of ₱280.00 per kilogram, liver condemnation resulted in an estimated direct economic loss of ₱22,288.00 during the one-month study period. These findings demonstrate that fasciolosis remains a significant animal health and economic concern in Baggao, Cagayan, emphasizing the need for strengthened abattoir surveillance, strategic deworming, improved grazing management, and integrated parasite control programs to reduce disease prevalence and minimize economic losses.

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INTRODUCTION

Carabaos (*Bubalus bubalis*) play a vital role in Philippine agriculture, serving as an important source of draft power, meat, milk, and income for smallholder farming communities. As the country's national animal, the carabao significantly contributes to food security and rural livelihoods, particularly in agricultural provinces such as Cagayan. However, the productivity and economic value of carabaos are often compromised by parasitic diseases, among which fasciolosis caused by *Fasciola gigantica* is one of the most important. This trematode parasite infects the liver and bile ducts of ruminants, causing chronic liver damage, reduced weight gain, poor reproductive performance, decreased work efficiency, and condemnation of affected livers during meat inspection. These adverse effects result in substantial economic losses to livestock owners, traders, and the meat industry while also posing a zoonotic risk to humans through the accidental ingestion of infective metacercariae (Mas-Coma *et al.*, 2019; Taylor *et al.*, 2016).

Fasciolosis is widely distributed throughout tropical and subtropical regions where environmental conditions favor the development of freshwater lymnaeid snails, the intermediate hosts of *F. gigantica*. In the Philippines, the disease remains endemic because of extensive rice-based farming systems, abundant irrigation canals, marshlands, and communal grazing areas that facilitate the transmission of the parasite. Infection occurs when grazing animals ingest vegetation or contaminated water containing infective metacercariae.

Although fasciolosis is often subclinical, infected animals may suffer significant production losses due to reduced feed efficiency, impaired growth, lower carcass quality, and liver condemnation at slaughter. Previous studies conducted in various regions of the Philippines have reported moderate to high prevalence of *F. gigantica* infection in cattle and carabaos, indicating that the disease continues to be a major constraint to ruminant production (Portugaliza *et al.*, 2019).

Abattoir-based surveillance provides an effective and practical approach for determining the prevalence of fasciolosis because postmortem examination allows direct visualization of adult liver flukes and pathological lesions that may not be detected through routine fecal examination. Information generated from slaughterhouse inspections also provides valuable insights into the epidemiology of the disease and the direct economic losses resulting from liver condemnation. Condemned livers represent an immediate financial loss because affected organs are declared unfit for human consumption and must be discarded. Beyond the value of the condemned liver, fasciolosis also contributes to indirect losses through reduced carcass weight, decreased productivity, increased veterinary costs, and prolonged finishing periods, further reducing profitability for livestock producers (Kaplan, 2001; Mungube *et al.*, 2006).

Despite the importance of carabao production in the Municipality of Baggao, Cagayan, information regarding the prevalence of *F. gigantica* infection and its associated economic impact remains limited. Most available studies have focused on live animal surveys using fecal examination, while relatively few have assessed liver fluke infection through postmortem inspection in local slaughterhouses. Furthermore, limited data exist regarding the influence of host-related factors such as age, sex, and breed on the occurrence of fasciolosis in slaughtered carabaos within the municipality. Updated epidemiological information is essential for understanding the current disease burden and identifying vulnerable animal groups that require targeted interventions.

This study was therefore conducted to determine the prevalence of *Fasciola gigantica* infection among slaughtered carabaos in the Municipality of Baggao, Cagayan, through postmortem liver examination over a one-month surveillance period. Specifically, the study evaluated the association of infection with selected host-related risk factors, including age, sex, and breed, and estimated the direct economic losses resulting from liver condemnation due to fasciolosis. The findings are

expected to provide baseline epidemiological data that will support evidence-based parasite control programs, strengthen meat inspection and disease surveillance, improve herd health management, and minimize the economic burden of fasciolosis on the local livestock industry.

The study aimed to determine the prevalence of *Fasciola gigantica* infection among slaughtered carabaos (*Bubalus bubalis*) through postmortem liver examination and to evaluate the associated host-related risk factors and direct economic impact in the Municipality of Baggao, Cagayan, Philippines. Specifically, it sought to determine the overall prevalence of *Fasciola gigantica* infection among slaughtered carabaos based on postmortem liver examination; determine the prevalence of infection according to the sex, breed, and age of the slaughtered carabaos; and assess the association between selected host-related factors (age, sex, and breed) and the occurrence of *Fasciola gigantica* infection.

MATERIALS AND METHODS

Research design and experimental lay-out

This study employed a cross-sectional descriptive research design using an abattoir-based survey to determine the prevalence of *Fasciola gigantica* infection among slaughtered carabaos (*Bubalus bubalis*) and to evaluate the association of selected host-related risk factors with infection. The cross-sectional design was considered appropriate because it allowed the determination of the occurrence of liver fluke infection within a defined population at a specific period while simultaneously assessing demographic variables such as age, sex, and breed. In addition, the study estimated the direct economic losses associated with liver condemnation due to fasciolosis. Similar abattoir-based epidemiological studies have been widely used in determining the prevalence and economic impact of fasciolosis in livestock because postmortem examination remains the gold standard for detecting adult liver flukes and assessing liver pathology (Taylor *et al.*, 2016; Mas-Coma *et al.*, 2019).

Time and locale of the study

The study was conducted in the Municipal Slaughterhouse of Baggao, Municipality of Baggao, Province of Cagayan, Philippines. Baggao is located in the southeastern portion of Cagayan Province and is characterized by extensive agricultural lands devoted primarily to rice, corn, and livestock production. The municipality has numerous irrigation systems, rivers, wetlands, and low-lying pasture areas that provide favorable habitats for freshwater snails belonging to the family Lymnaeidae, the intermediate hosts of *Fasciola gigantica*. These environmental conditions facilitate the completion of the parasite's life cycle and contribute to the persistence of fasciolosis among grazing ruminants.

The Municipal Slaughterhouse serves as the principal slaughter facility for livestock originating from Baggao and neighboring municipalities. Routine ante-mortem and postmortem meat inspections are conducted by accredited meat inspectors following the standards prescribed by the National Meat Inspection Service (NMIS). The slaughterhouse therefore provides an appropriate location for epidemiological surveillance of liver fluke infection through direct examination of slaughtered animals.

The study was conducted over a one-month period, from January 5, 2026 to February 2, 2026 during which all eligible slaughtered carabaos presented at the Municipal Slaughterhouse of Baggao were examined for the presence of *Fasciola gigantica*. Data collection was performed continuously throughout the study period to minimize sampling bias associated with slaughter schedules.

Sampling

The study population consisted of 31 slaughtered carabaos (*Bubalus bubalis*) presented for routine slaughter at the Municipal Slaughterhouse of Baggao during the study period. Each slaughtered animal represented one sampling unit.

Inclusion criteria

Carabaos were included in the study if they: were slaughtered during the study period; underwent

complete postmortem inspection; had intact liver specimens available for examination; and possessed complete information regarding sex, age, and breed.

Exclusion criteria

Animals were excluded if: the liver was severely damaged during slaughter preventing complete examination; demographic information was incomplete; or the liver originated from another slaughterhouse.

Sampling technique and analysis

A complete enumeration (total population sampling) technique was employed. All slaughtered carabaos presented during the one-month study period that satisfied the inclusion criteria were included in the investigation. Since the daily slaughter population was relatively small, complete enumeration minimized selection bias and ensured that the prevalence estimates accurately reflected the slaughter population during the study period.

Postmortem examination

Immediately following slaughter, each liver was subjected to a systematic postmortem examination by the researchers in coordination with the municipal meat inspector. The liver was first visually inspected for abnormalities including: enlargement, discoloration, fibrosis, thickened bile ducts, calcification, hemorrhages, abscess formation, and migratory tracts suggestive of fasciolosis.

Thereafter, multiple deep longitudinal and transverse incisions were made through the major hepatic lobes and bile ducts using sterile knives to expose the internal tissues. Gentle manual palpation was performed to detect embedded adult flukes.

Adult *Fasciola gigantica* were identified based on their characteristic morphology including: flattened leaf-like body, pointed anterior cone, broad posterior body, brownish coloration, body length of approximately 25–75 mm, width of 5–12 mm, branched intestinal caeca, and highly dendritic testes. Livers in which one or more adult liver flukes were observed were classified as positive.

Data collection

Data were collected from each slaughtered carabao using a standardized data collection sheet developed specifically for the study. The information recorded included the animal identification number, sex, age, breed, presence or absence of *Fasciola gigantica* infection based on postmortem liver examination, liver weight (kg), liver market price (₱280/kg), and the corresponding estimated economic loss resulting from liver condemnation.

For the assessment of host-related risk factors, animals were classified according to sex, breed, and age. Sex was categorized as either male or female, while breed was classified as either native or Murrah. Age was grouped into three production categories: 1–3 years, 4–5 years, and 6–10 years. No animals aged 11 years or older were slaughtered during the study period. These classifications were used to evaluate their association with the occurrence of *Fasciola gigantica* infection.

Determination of economic loss

The direct economic loss attributable to fasciolosis was estimated based on liver condemnation during postmortem inspection. Each infected liver was weighed using a calibrated digital weighing scale. The prevailing market price of fresh carabao liver during the study period was ₱280.00 per kilogram. The economic loss per condemned liver was computed using the equation:

$$\text{Economic Loss} = \text{Liver weight (kg)} \times \text{Market price (₱/kg)}$$

The total economic loss was calculated by summing the estimated value of all condemned livers.

Data analysis

All data were encoded using Microsoft Excel and analyzed using IBM SPSS Statistics version 27 (or equivalent statistical software). Descriptive statistics including frequency, percentage, mean, and standard deviation were used to summarize the data. The prevalence of *Fasciola gigantica* infection was calculated using the formula:

$$\text{Prevalence Rate (\%)} = \frac{\text{Number of Infected Carabaos}}{\text{Total number of samples}} \times 100\%$$

The association between liver fluke infection and the host-related variables (sex, age, and breed) was evaluated using the Pearson Chi-square (χ^2) test. Crude odds ratios (OR) with 95% confidence intervals were computed to estimate the strength of association between selected risk factors and *F. gigantica* infection. Statistical significance was declared at $p < 0.05$.

Descriptive percentages was used to express the proportion of infected carabaos relative to the total number sampled. Statistical tools like mean, frequency count percentage are used as a ration in analyzing and presenting the prevalence of *Fasciola gigantica* infection in carabaos. The formula is:

$$P = \frac{F}{N} \times 100\%$$

Where:

P- Percentage

F- Frequency

N- Total number of respondents 100 % is constant

Ethical consideration

No live animals were handled or subjected to invasive procedures specifically for this research. All liver specimens were collected from animals slaughtered as part of routine commercial operations at the Municipal Slaughterhouse of Baggao. Postmortem examinations were conducted in collaboration with the municipal meat inspector following the sanitary and meat inspection guidelines of the National Meat Inspection Service (NMIS). Confidentiality of livestock owners and slaughter records was maintained throughout the study.

RESULTS

Prevalence of *Fasciola gigantica* infection among slaughtered carabaos in Baggao, Cagayan

A total of 31 slaughtered carabaos (*Bubalus bubalis*) were examined through postmortem liver inspection over a one-month surveillance period at the Municipal Slaughterhouse of Baggao, Cagayan (Table 1). Each liver was thoroughly inspected for the presence of adult

Fasciola gigantica and characteristic pathological lesions. The overall prevalence and the distribution of infection according to sex, breed, and age are presented in the succeeding Table 2.

Table 1. Overall prevalence of *Fasciola gigantica* infection

Infection status	Number	Percentage
Positive	15	48.39%
Negative	16	51.61%
Total	31	100.00

Table 2. Prevalence according to sex

Sex	Positive	Negative	Total	Prevalence (%)
Male	10	9	19	52.63
Female	5	7	12	41.67
Total	15	16	31	48.39

The postmortem examination revealed that 15 of the 31 slaughtered carabaos were infected with *Fasciola gigantica*, resulting in an overall prevalence of 48.39%. This finding indicates that nearly one out of every two slaughtered animals carried adult liver flukes, suggesting that fasciolosis remains highly prevalent among carabaos entering the slaughterhouse in Baggao, Cagayan.

Male carabaos exhibited a prevalence of 52.63%, whereas females had a prevalence of 41.67%. Although infection appeared numerically higher among males, the difference was relatively small and is unlikely to represent a biologically meaningful difference given the limited sample size.

Native carabaos exhibited a prevalence of 51.72%, whereas none of the two Murrah animals examined were infected (Table 3). The higher prevalence among native carabaos is more plausibly explained by management practices than by genetic factors. Native buffaloes are generally reared extensively under traditional grazing systems that involve continuous exposure to marshy pasture and irrigated rice fields. Murrah buffaloes, in contrast, are often maintained under more intensive or semi-intensive production systems where exposure to contaminated grazing areas is reduced. Previous investigations indicate that environmental exposure and grazing management are considerably stronger

determinants of fasciolosis than breed (Taylor *et al.*, 2016; Mas-Coma *et al.*, 2019).

Table 3. Prevalence according to breed

Breed	Positive	Negative	Total	Prevalence (%)
Native	15	14	29	51.72
Murrah	0	2	2	0.00
Total	15	16	31	48.39

Age showed a marked influence on the occurrence of *Fasciola gigantica* infection. The highest prevalence was observed among carabaos aged 1–3 years (77.78%), followed by those aged 4–5 years (44.44%), while animals aged 6–10 years had the lowest prevalence (30.77%) (Table 4).

Table 4. Prevalence according to age

Age	Positive	Negative	Total	Prevalence (%)
1–3 years	7	2	9	77.78
4–5 years	4	5	9	44.44
6–10 years	4	9	13	30.77
Total	15	16	31	48.39

Postmortem examination identified 15 livers that were infected with *F. gigantica* and consequently considered unfit for human consumption. The condemned livers had a combined weight of 79.6 kg, corresponding to an average liver weight of 5.31 kg. Based on the prevailing local market price of ₱280.00 per kilogram, the total direct economic loss due to liver condemnation during the one-month surveillance period was estimated at ₱22,288.00 (Table 5).

Table 5. Estimated direct economic loss due to liver condemnation

Parameter	Value
Positive livers condemned	15
Total liver weight	79.6 kg
Average liver weight	5.31 kg
Market price	₱280.00/kg
Estimated economic loss	₱22,288.00

These findings demonstrate the immediate financial consequences of fasciolosis at the slaughterhouse level. Liver condemnation represents a direct loss because the organ cannot be marketed for human consumption. For smallholder farmers and meat traders, repeated condemnation of edible organs reduces income and overall carcass value. Moreover, this estimate reflects only the direct loss associated

with discarded livers and does not account for indirect costs such as reduced live weight gain, lower feed efficiency, diminished reproductive performance, decreased draft capacity, veterinary treatment expenses, or additional labor required for disease management.

The Chi-square analysis demonstrated that sex ($p = 0.554$), breed ($p = 0.144$), and age ($p = 0.113$) were not significantly associated with the occurrence of *Fasciola gigantica* infection among slaughtered carabaos at the 5% level of significance (Table 6).

Table 6. Chi-square test of association between *Fasciola gigantica* infection and selected host factors

Variable	χ^2 value	df	p-value	Interpretation
Sex	0.35	1	0.554	Not significant
Breed	2.14	1	0.144	Not significant
Age	4.36	2	0.113	Not significant

Male carabaos had 1.56 times greater odds of being infected than female carabaos ($OR = 1.56$; 95% $CI = 0.35–6.89$). However, because the confidence interval includes 1.00 and the Chi-square test was not significant ($\chi^2 = 0.35$; $p = 0.554$), sex was not identified as a significant risk factor.

Native carabaos exhibited approximately 4.5 times greater odds of infection than Murrah animals ($OR = 4.48$; 95% $CI = 0.20–98.40$). Despite this large point estimate, the association was not statistically significant because the confidence interval was extremely wide and included unity. The wide interval reflects the very small number of Murrah animals ($n = 2$), making the estimate unstable (Table 7).

Carabaos aged 1–3 years had 7.88 times greater odds of infection than animals aged 6–10 years ($OR = 7.88$; 95% $CI = 1.10–56.52$). Although the odds ratio suggests substantially higher susceptibility among younger animals, the overall Chi-square test did not demonstrate a statistically significant association among age groups ($\chi^2 = 4.36$; $p = 0.113$).

Although younger animals exhibited higher prevalence rates than older animals, the observed differences were not statistically significant. This

finding is likely influenced by the relatively small sample size ($n = 31$), which reduces the statistical power to detect true differences among groups. Likewise, the absence of infection among the two Murrah animals should not be interpreted as

evidence of breed resistance because the sample size for this breed was insufficient for meaningful comparison. Nevertheless, the descriptive results indicate biologically relevant trends that warrant further investigation using a larger population.

Table 7. Crude (OR) for risk factors associated with *Fasciola gigantica* infection

Variable	Comparison	Odds ratio	95% confidence interval	Interpretation
Sex	Male vs Female	1.56	0.35–6.89	Not significant
Breed*	Native vs Murrah	4.48	0.20–98.40	Not significant
Age	1–3 yrs vs 6–10 yrs	7.88	1.10–56.52	Higher odds
Age	4–5 yrs vs 6–10 yrs	1.80	0.31–10.41	Not significant

*A continuity correction (Haldane–Anscombe correction) was applied because no Murrah animals were infected.

DISCUSSION

Of the 31 slaughtered carabaos examined through postmortem liver inspection, 15 were found to be infected with *Fasciola gigantica*, corresponding to an overall prevalence of 48.39%. This finding indicates a relatively high occurrence of fasciolosis among slaughtered carabaos in Baggao, Cagayan, with almost one in every two animals exhibiting adult liver fluke infection. The high prevalence suggests that *F. gigantica* continues to be endemic in the area and highlights the potential role of local environmental conditions and traditional grazing practices in sustaining parasite transmission. These results emphasize the importance of implementing regular surveillance, strategic deworming, and integrated parasite control measures to minimize the impact of fasciolosis on carabao production.

The relatively high prevalence may be attributed to the ecological characteristics of the municipality, which include irrigated rice fields, swamps, rivers, and wetlands that provide ideal habitats for lymnaeid snails, the intermediate hosts of *F. gigantica*. Carabaos grazing in these environments are continuously exposed to infective metacercariae attached to aquatic vegetation and contaminated pasture. Since fasciolosis is often chronic and subclinical, infected animals may appear clinically healthy and therefore proceed to slaughter without prior diagnosis.

Comparable prevalence rates have been reported in abattoir surveys conducted in other tropical

countries where environmental conditions favor the transmission of liver flukes. Mungube *et al.* (2006) reported prevalence values ranging from 30% to 60% among slaughtered cattle in endemic regions, while Mas-Coma *et al.* (2019) identified tropical grazing ecosystems as major determinants of persistent fasciolosis transmission. Similar observations have also been documented in Philippine livestock, where irrigation systems and communal grazing contribute to sustained parasite transmission (Portugaliza *et al.*, 2019).

The slightly higher prevalence among males may reflect differences in grazing duration, work-related movement, or management practices. In many farming communities, male carabaos are traditionally utilized for draft purposes and may spend longer periods grazing in communal pastures and irrigated fields following agricultural activities, increasing opportunities for exposure to infective metacercariae.

However, previous epidemiological studies have generally reported inconsistent associations between sex and fasciolosis. Kaplan (2001) and Taylor *et al.* (2016) emphasized that exposure to contaminated environments rather than sex is the principal determinant of infection. Consequently, the observed difference is more likely attributable to management and environmental exposure than to inherent biological susceptibility.

The higher prevalence among native carabaos is more plausibly explained by management practices

than by genetic factors. Native buffaloes are generally reared extensively under traditional grazing systems that involve continuous exposure to marshy pasture and irrigated rice fields. Murrah buffaloes, in contrast, are often maintained under more intensive or semi-intensive production systems where exposure to contaminated grazing areas is reduced.

Previous investigations indicate that environmental exposure and grazing management are considerably stronger determinants of fasciolosis than breed (Taylor *et al.*, 2016; Mas-Coma *et al.*, 2019).

The progressive decline in prevalence with increasing age suggests that younger animals are more susceptible to liver fluke infection. One explanation is that young animals have not yet developed the partial acquired immunity that can arise after repeated exposure to *F. gigantica*.

Additionally, younger animals often graze more indiscriminately and may consume vegetation growing in wet, low-lying areas where infective metacercariae are abundant.

These findings are consistent with studies indicating that younger ruminants have greater susceptibility to fasciolosis than mature animals (Kaplan, 2001; Beesley *et al.*, 2018). The lower prevalence among older carabaos may reflect cumulative immune responses, improved physiological resilience, or selective culling of severely affected animals before they reach older ages.

The results emphasize the importance of targeting younger animals in strategic deworming and parasite control programs, particularly before the rainy season when snail populations and transmission rates increase.

The substantial economic loss observed during only one month of surveillance underscores the importance of implementing integrated fasciolosis control strategies, including strategic anthelmintic

treatment, improved grazing management, drainage of snail-infested areas where feasible, and strengthened meat inspection programs. Such interventions would reduce infection pressure within the herd, improve animal productivity, and minimize financial losses to livestock owners and the local meat industry.

CONCLUSION

The findings indicate that *Fasciola gigantica* infection remains highly prevalent among slaughtered carabaos in Baggao, Cagayan. Younger animals exhibited the highest prevalence, while differences according to sex and breed were less pronounced. The considerable economic loss resulting from liver condemnation highlights the need for sustained surveillance and evidence-based parasite control measures to protect both livestock productivity and farmer livelihoods.

The statistical analyses indicate that none of the evaluated host-related variables reached statistical significance at the 5% level. Nevertheless, descriptive and odds ratio analyses suggest that young carabaos (1–3 years) tended to have the highest risk of infection. Male carabaos showed only a modest increase in infection odds compared with females. Native carabaos had higher observed infection rates than Murrah animals, although this comparison is limited by the very small number of Murrah buffaloes examined.

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