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Prevalence and risk factors of *Fasciola gigantica* infection in carabaos (*Bubalus bubalis*) in selected municipalities in the Province of Cagayan, Philippines

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ABSTRACT

Fasciola gigantica infection remains one of the most important parasitic diseases affecting carabaos (*Bubalus bubalis*) in the Philippines due to its detrimental effects on animal health, productivity, and the livestock industry. This study determined the prevalence of *Fasciola gigantica* infection and evaluated selected host- and management-related risk factors among carabaos in selected municipalities of Southern Cagayan. A cross-sectional study was conducted involving 1,079 randomly selected carabaos. Fecal samples were collected through rectal retrieval and examined using the formalin ethyl acetate sedimentation technique with methylene blue staining for the detection of *Fasciola gigantica* eggs. Data on the animals' age, sex, breed, and feeding methods were collected using a structured questionnaire administered to the owners. The overall prevalence of *Fasciola gigantica* infection was 10.75% (116/1,079). Male carabaos exhibited a prevalence of 10.78%, while females had 10.70%, indicating minimal variation between sexes. Infection was detected in both native and Murrah breeds, with comparable prevalence rates. Age-related analysis showed that younger carabaos had higher infection rates than older animals, suggesting greater susceptibility among immature stock. Feeding methods, particularly grazing in communal and irrigated pastures, were identified as important management factors associated with parasite transmission. These findings demonstrate that age and feeding practices are important determinants of *Fasciola gigantica* infection and highlight the need for strategic deworming, improved pasture management, and regular parasitological surveillance to reduce fasciolosis and improve carabao health and productivity in Southern Cagayan.

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INTRODUCTION

Carabaos (*Bubalus bubalis*) are among the most valuable livestock species in the Philippines, providing draft power, meat, milk, and income to rural farming communities. Their contribution to agricultural productivity, however, is often compromised by parasitic diseases, particularly fasciolosis caused by *Fasciola gigantica*. This trematode parasite infects the liver and bile ducts of ruminants, resulting in reduced growth, decreased reproductive performance, lower work efficiency, and condemnation of infected livers during slaughter, thereby causing considerable economic losses to the livestock industry. The persistence of fasciolosis in tropical countries such as the Philippines is largely attributed to favorable environmental conditions that support the survival of freshwater lymnaeid snails, the intermediate hosts of the parasite, and the widespread practice of grazing animals in irrigated rice fields and marshy pastures (Mas-Coma *et al.*, 2019; Beesley *et al.*, 2018).

The occurrence of *Fasciola gigantica* infection is influenced by several host- and management-related factors. Previous studies have shown that age is an important determinant of infection, with younger animals generally exhibiting higher susceptibility because of their limited acquired immunity, while older animals may develop partial resistance after repeated exposure. Differences in infection according to sex and breed have also been investigated, although findings vary among geographical locations and production systems. Feeding methods likewise play a critical role in disease transmission, as carabaos that graze freely on communal pastures, rice fields, and areas with abundant aquatic vegetation are more likely to ingest infective metacercariae than animals maintained under controlled or cut-and-carry feeding systems. Understanding the influence of these factors is essential for identifying vulnerable animal groups and developing effective parasite control strategies (Kaplan, 2001).

Southern Cagayan is characterized by extensive rice-based farming systems, irrigation networks, and lowland grazing areas that may favor the transmission of *Fasciola gigantica* . Despite these environmental conditions, recent epidemiological data on fasciolosis among carabaos in the province remain limited. Determining the prevalence of infection and evaluating the effects of age, sex, breed, and feeding methods will provide valuable baseline information for veterinarians, livestock owners, and local government agencies in designing evidence-based parasite control programs. The findings of this study are expected to contribute to improved herd health management, enhanced livestock productivity, and strengthened surveillance of fasciolosis in Southern Cagayan.

Generally, this study aimed to determine the prevalence and risk factors of *Fasciola gigantica* infection in carabaos *(Bubalus bubalis)* in selected municipalities in Cagayan.

Specifically, the study aims to:

1. Determine the overall prevalence of Fasciola gigantica infection among carabaos using simple sedimentation technique.
2. Determine the prevalence of *Fasciola gigantica* infection according to the sex of the carabaos.
3. Determine the prevalence of *Fasciola gigantica* infection according to the breed of the carabaos.
4. Determine the prevalence of *Fasciola gigantica* infection according to the age of the carabaos.
5. Evaluate the association between age, sex, and breed with the occurrence of *Fasciola gigantica* infection among carabaos.

MATERIALS AND METHODS

Research design and experimental lay-out

A cross-sectional survey was conducted among selected municipalities in the province of Cagayan to determine the prevalence of *Fasciola gigantica* infection in carabaos. The total carabao population was obtained from the designated Municipal Agriculture Offices of 4 municipalities namely Iguig, Penablanca, Baggao, and Solana. Using Slovin's formula at a 95% confidence level, the required sample size was computed, resulting in 1079 carabaos

included in the study. Sampling was conducted in selected barangays with a high carabao population.

Fecal samples were collected from the selected animals and examined using standard parasitological techniques to detect the presence of *Fasciola gigantica* eggs. In addition, a structured questionnaire was administered to the carabao owners to gather information regarding their socio-demographic profile and their feeding methods. The collected data were recorded and analyzed to determine the prevalence of infection among the sampled carabaos in the study area.

Time and locale of the study

Fecal sample collection and the accompanying survey were carried out in four municipalities in Cagayan, namely the municipalities of Baggao, Iguig, Penablanca, and Solana, from September to November 2025. Microscopic examinations of the samples were performed during the same period at the Parasitology Laboratory of the College of Veterinary Medicine, Cagayan State University – Carig Campus.

Methods and sampling

A cross-sectional survey was employed to determine the prevalence of *Fasciola gigantica* in carabaos in the southern municipalities of Cagayan. A random sampling method was used to select carabaos from various barangays with a highest number of carabao population in the municipality. A total of 1,079 heads of carabaos registered based on the census as of 2025 were used to represent the population to ensure that the number of samples accurately represents the area. This sample size is chosen to provide reliable and precise estimates of how common the infection is in the area.

Fecal sampling and analysis

Fecal samples were collected from each carabao either through direct rectal collection or free-catch method, with about 50 grams of feces obtained per animal. Each sample were placed in a labeled container with lid cover indicating the animal sex and age, animal owner, and place of origin. Fecal samples were added with 10% formalin at a ratio of 1part fecal sample:3 parts formalin and were stored in an ice box during transportation. Detection and identification of *Fasciola gigantica* eggs were carried out using Formalin Ethyl-Acetate Sedimentation technique.

Table 1. Calculated total number of Carabaos for sampling based on the 5 highest populated number of Carabaos per Barangay on 4 municipalities in Southern Cagayan from the Year 2025

Municipality	Barangay	Sample size	Total
Baggao	Awallan	72	
	Agaman Norte	71	
	Bitag grande	71	
	Hacienda-Intal	71	
	Imurung	71	
Total		356	
Iguig	Sta Barbara	40	
	San Esteban	40	
	San Vicente	40	
	Campo	40	
	Baculud	40	
Total		200	
Penablanca	Aggugadan	16	
	Baliwag	25	
	Bical	24	
	Minanga	24	
	Quibal	84	
Total		173	
Solana	Iraga	70	
	Sampaguita	70	
	Dassun	70	
	Cattaran	70	
	Bauan West	70	
Total		350	
Total number of samples examined			1079

Fecal sedimentation

The Formalin-Ethyl Acetate Sedimentation technique begins with thoroughly mixing the stool specimen. Approximately 5 mL of the fecal suspension (adjusted based on consistency) were strained through wetted cheesecloth-type gauze placed over a disposable paper funnel into a 15 mL conical centrifuge tube using a paper funnel or improvised alternative. To this, 0.85% saline or 10% formalin was added through the debris to bring the volume to 15 mL, Distilled water may be used. The sample was then centrifuged at 500 × g for 10 minutes, after which the supernatant was decanted. Ten milliliters of 10% formalin were added to the resulting sediment and mixed

thoroughly using wooden applicator sticks. Four milliliters of ethyl acetate were then added, stopper the tube and shaken vigorously in an inverted position for 30 seconds. After carefully removing the stopper, the sample was centrifuged again at 500 × g for 10 minutes. The plug of debris at the top was freed using an applicator stick, and the top layers were decanted. Any residual debris clinging to the sides of the tube was removed with a cotton-tipped applicator. Finally, a few drops of 10% formalin were added to resuspend the concentrated specimen for subsequent microscopic examination or other relevant diagnostic procedures.

Identification and characterization of *Fasciola* eggs

The processed fecal samples were examined under a light microscope using the scanning (4×), low-power (10×), and high-power (40×) objectives for parasite detection. According to Phalee *et al.*, (2015), *Fasciola gigantica* eggs measure 120-180 µm x 80-110 µm or 0.12-0.18 mm in length x 0.08-0.11 mm in width, characterized as large, oval, yellowish-brown, thin-shelled, operculated, and having a smooth outer surface and a distinct inner concave operculum while *Fasciola hepatica* eggs measure 130-150 µm x 60-90 µm with short straight operculum. Identification of Fasciola eggs was done following the description of Mas-coma *et al.* (2014) (Fig. 1).

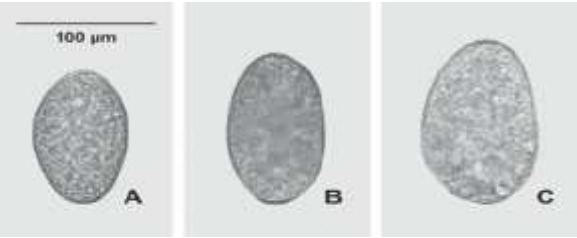

Fig. 1. Fasciola eggs (A) egg of *Fasciola hepatica*; (B) egg of an Intermediate form; (C) egg of *Fasciola gigantica*. All eggs at the same scale. (Mas-coma *et al.*, 2014)

Host animal and environmental risk factor assessment

Farmers were interviewed to collect data on their demography, animal host factors, like age, sex, and breed, environmental risk factors, such as grazing locations for carabaos, the quality of their water sources, and prevailing sanitation practices. In parallel, the study assessed the presence of freshwater snails, which serve as intermediate hosts in the transmission of fluke infections. Mapping areas with dense snail populations and/or high infection rates helps pinpoint potential disease transmission hotspots. This spatial approach enhances surveillance of liver fluke risk zones.

Selection criteria for participants

The participants for the survey were selected based on the following: they should have a carabao/s to be included in the fecal collection; consent to participate in the survey; they should be more than or at least 15 years old.

Data gathering

This study utilized survey questionnaires to collect data from carabao owners in the municipality of Iguig, Cagayan. In addition to gathering information on demographic profiles, management, and animal care practices, this research also examined the prevalence of *Fasciola gigantica* infection among carabaos. The prevalence data was obtained in a laboratory through parasitological analysis of fecal samples through Formalin-Ethyl Acetate Sedimentation technique.

Data analysis

The prevalence was determined by finding the percentage of animals that test positive out of all the animals sampled. The prevalence rate of *Fasciola gigantica* in carabaos is obtain using the formula:

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

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

Chi-Square test was used to determine the association of risk factors with the prevalence rate. The odds ratio between variables were also determined using logistic regression.

Ethical consideration

In conducting the study on the prevalence of *Fasciola gigantica* in carabaos in the municipality of Iguig, Cagayan, ethical considerations must address both the rights of human participants, and the welfare of animals involved in the study. Every carabao owner taking part in the study was thoroughly told about its goals, methods, possible dangers, and advantages. Owners were guaranteed the freedom to decline or withdraw from the study at any moment without any negative consequences. To protect participants' privacy throughout the research process, informed consent was acquired before any data or sample is collected, and all answers and private information were handled with strict confidentiality.

In addition, an Institutional Animal Care and Use Committee (IACUC) reviewed and approved the research procedures to guarantee that carabao handling and fecal sample collection were done humanely, reducing stress, pain, or injury to the animals.

Finally, the study maintained transparency, accountability, and proper documentation, with all protocols, consent forms, and data securely archived as required by ethical and legal regulations. This comprehensive approach ensured that the research was conducted with respect for both human and animal participants, safeguarding their welfare and rights while generating valuable knowledge on fasciolosis in the province of Cagayan.

RESULTS

The present study demonstrated an overall prevalence of 10.75% (116/1,079) for Fasciola gigantica infection among carabaos from selected municipalities in Southern Cagayan. This finding indicates that approximately one in every ten carabaos examined was infected with liver flukes, confirming that fasciolosis remains endemic in the study area (Fig. 2).

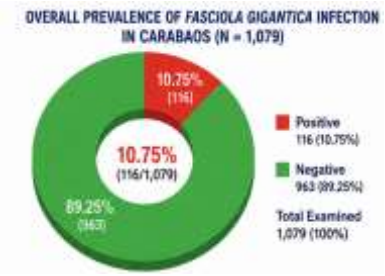

Fig. 2. Overall prevalence of *Fasciola gigantica* infection in carabaos in selected municipalities of Southern Cagayan

Although the prevalence observed is lower than those reported in several endemic regions of the Philippines, the presence of infection remains epidemiologically significant because infected animals continuously contaminate grazing areas through the shedding of parasite eggs (Fig. 3). Even animals with subclinical infections may experience reduced weight gain, poor reproductive performance, decreased work efficiency, and chronic liver damage, resulting in substantial economic losses among smallholder farmers.

(a) (b)

Fig. 3. Actual microscopic appearance of *Fasciola gigantica* ova in fecal sample stained with methylene blue (a) Low power objective (10x). (b) High power objective (40x).

The difference between sexes is minimal, suggesting that sex alone is unlikely to be a major determinant of *Fasciola gigantica* infection.

Native carabaos accounted for the majority of positive cases because they comprised more than 95% of the

study population. Breed differences appeared minimal and likely reflect differences in population size rather than genetic susceptibility.

Age exhibited a marked influence on the prevalence of *Fasciola gigantica* infection. Carabaos aged one to five years had the highest prevalence, whereas animals older than eleven years showed the lowest prevalence (1.78%).

The Pearson Chi-square analysis demonstrated no significant association between sex and the occurrence of *Fasciola gigantica* infection ($\chi^2 = 0.000$, df = 1, $p = 1.000$). Male and female carabaos exhibited nearly identical prevalence rates (10.78% and 10.70%, respectively), indicating that sex did not influence the likelihood of infection in the study population (Table 2, 3, 4, Fig. 4).

Table 2. Prevalence according to sex

Sex	Positive	Negative	Total	Prevalence
Male	73	604	677	10.78%
Female	43	359	402	10.70%

Male carabaos exhibited a slightly higher prevalence (10.78%) than females (10.70%).

Table 3. Prevalence according to breed

Breed	Positive	Negative	Total	Prevalence
Native	110	919	1029	10.69%*
Murrah	6	44	50	12.00%*

Table 4. Pearson Chi-square test of association

Variable	χ^2	df	p-value	Interpretation
Sex	0.000	1	1.000	Not significant
Breed	0.003	1	0.954	Not significant
Age	25.771	3	<0.001	Highly significant

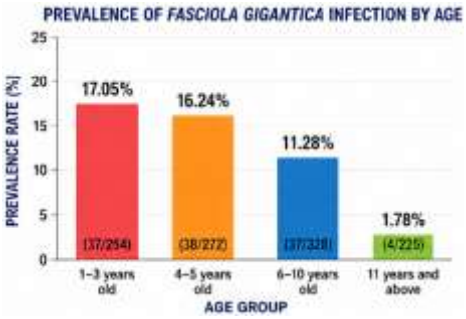

Fig. 4. Prevalence according to age

Association between breed and *Fasciola gigantica* infection: Breed likewise showed no statistically significant association with liver fluke infection ($\chi^2 = 0.003$, df = 1, $p = 0.954$).

Association between age and *Fasciola gigantica* infection: Age demonstrated a highly significant association with liver fluke infection ($\chi^2 = 25.771$, df = 3, $p < 0.001$).

Younger animals exhibited substantially higher infection rates than older animals. The lowest prevalence occurred among carabaos aged 11 years and above, indicating that infection decreases with increasing age.

Sex

The crude odds ratio indicated that male carabaos were 1.01 times more likely to be infected with *Fasciola gigantica* than female carabaos (OR = 1.01; 95% CI = 0.68–1.49). Because the confidence interval includes 1.00, there is no statistically significant association between sex and liver fluke infection.

Breed

Murrah buffaloes had 1.14 times greater odds of infection than native buffaloes (OR = 1.14; 95% CI = 0.48–2.69). However, the confidence interval crossed unity, indicating that breed was not a statistically significant risk factor (Table 5).

Age

Age exhibited the strongest association with liver fluke infection. Compared with carabaos aged 11 years and above, animals aged.

Table 5. Crude odds ratios for selected risk factors associated with *Fasciola gigantica* infection in Carabaos

Variable	Odds Ratio (OR)	95% CI	Interpretation
Sex			
Male vs Female	1.01	0.68–1.49	No association
Breed			
Murrah vs Native	1.14	0.48–2.69	No association
Age			
1–3 yrs vs ≥11 yrs	9.42	3.35–26.49	Significant increase in odds
4–5 yrs vs ≥11 yrs	8.99	3.20–25.25	Significant increase in odds
6–10 yrs vs ≥11 yrs	7.03	2.50–19.77	Significant increase in odds

1–3 years had 9.42 times higher odds of infection;
4–5 years had 8.99 times higher odds;
6–10 years had 7.03 times higher odds.

These findings demonstrate a clear decline in infection risk with increasing age.

The higher susceptibility of younger animals may be attributed to their limited acquired immunity. Repeated exposure to *Fasciola gigantica* stimulates protective immune responses that reduce parasite establishment in older animals. Younger carabaos also exhibit more exploratory grazing behavior, increasing the likelihood of consuming contaminated forage or aquatic vegetation.

DISCUSSION

Globally, fasciolosis remains one of the most economically important helminth diseases affecting domestic ruminants. The Food and Agriculture Organization recognizes fasciolosis as a major constraint to livestock productivity due to reduced milk production, carcass weight, fertility, and increased liver condemnation during meat inspection. The parasite also represents an emerging zoonosis affecting millions of people worldwide.

Southern Cagayan experiences seasonal flooding and extensive rice-based agriculture that favor the development of freshwater snails belonging to the family Lymnaeidae, the intermediate hosts of *Fasciola gigantica*. However, compared with highly endemic areas in Eastern Visayas, several municipalities in Southern Cagayan have gradually adopted strategic deworming and improved grazing management, which may partially explain the lower prevalence observed.

The present study demonstrated an overall prevalence of 10.75% (116/1,079) for Fasciola gigantica infection among carabaos from selected municipalities in Southern Cagayan. This finding indicates that approximately one in every ten carabaos examined was infected with liver flukes, confirming that fasciolosis remains endemic in the study area.

The prevalence observed in the present investigation is considerably lower than the 50.81% prevalence reported by Lumain and Balala (2019) among slaughtered carabaos in Leyte and the 63.58% prevalence reported by Portugaliza *et al.* (2019) in Baybay City, Leyte. These differences may be attributed to ecological variations, climatic conditions, grazing systems, diagnostic approaches, and implementation of parasite control programs.

From an epidemiological standpoint, the current prevalence indicates active transmission within the study sites. Continuous surveillance is therefore necessary because climatic variability, irrigation expansion, and changes in grazing practices may rapidly alter transmission dynamics.

The difference between sexes is minimal, suggesting that sex alone is unlikely to be a major determinant of Fasciola gigantica infection. The similar infection rates observed may be explained by the fact that both male and female animals are generally exposed to identical grazing environments, irrigation canals, and communal pastures where infective metacercariae accumulate.

This finding agrees with the Chi-square analysis, indicating that sex is not an important determinant of

fasciolosis in the study area. Similar infection rates likely reflect the common management system practiced by farmers, where both male and female animals graze in the same communal pastures and are exposed to identical environmental sources of infection. Comparable findings have been reported by Mas-Coma *et al.* (2019), who noted that host sex generally has minimal influence on Fasciola infection when environmental exposure is similar.

Comparable findings were reported by Portugaliza *et al.* (2019), who observed no statistically significant association between sex and Fasciola infection among buffaloes in Leyte.

Likewise, Kurnianto *et al.* (2022) concluded that environmental exposure rather than host sex primarily determines infection risk in tropical production systems.

Conversely, some investigations have reported higher infection rates among female animals due to physiological stress associated with pregnancy and lactation. Nevertheless, these differences frequently disappear after adjusting for grazing management and age.

The present findings suggest that control programs should focus on environmental management rather than sex-specific interventions.

Breed differences appeared minimal and likely reflect differences in population size rather than genetic susceptibility. Previous studies have consistently shown that management practices exert a stronger influence on fasciolosis than breed. Animals grazing in marshy rice fields and irrigated pastures have greater exposure regardless of genetic background.

The absence of a significant breed effect suggests that susceptibility to *Fasciola gigantica* is driven primarily by environmental exposure rather than genetic background. Both native and Murrah animals are commonly raised under similar production systems in Southern Cagayan, where grazing on communal pasture and irrigated agricultural lands facilitates exposure to infective metacercariae. Previous studies in Southeast Asia have similarly concluded that management practices outweigh breed differences in determining infection risk.

Carabaos aged one to five years had the highest prevalence, whereas animals older than eleven years showed the lowest prevalence (1.78%).

This pattern suggests that younger animals experience greater susceptibility because they have not yet developed partial acquired immunity following repeated exposure. Several studies have demonstrated that repeated infections stimulate immune responses capable of reducing parasite establishment in older animals.

Younger animals also tend to graze indiscriminately and consume vegetation close to irrigation channels where metacercariae accumulate, increasing infection risk.

Several studies support these findings. Kaplan (2001) reported that repeated exposure results in partial immunity among mature cattle and buffaloes. Likewise, Beesley *et al.* (2018) emphasized that younger grazing animals consistently exhibit higher prevalence because of greater susceptibility and higher exposure to contaminated environments. Mas-Coma *et al.* (2019) similarly described age as one of the most consistent epidemiological predictors of fasciolosis in endemic tropical regions.

The markedly elevated odds ratios observed among younger age groups suggest that strategic deworming programs should prioritize calves and young adults before the onset of the rainy season, when transmission is greatest.

Similar age-related trends have been reported in studies conducted in Ethiopia, Indonesia, Thailand, and the Philippines, where younger buffaloes consistently exhibited higher infection rates than mature animals.

CONCLUSION

The results revealed an overall prevalence rate of 116 carabaos out of 1079 carabaos (10.76%), indicating moderate endemicity, with the highest prevalence observed in the Municipality of Solana.

Among the evaluated risk factors, age emerged as the only major epidemiological determinant of *Fasciola gigantica* infection. Young carabaos were 7 to 9 times more likely to acquire infection than older animals, highlighting the importance of age-targeted parasite control strategies. Conversely, sex and breed showed no meaningful association with infection, indicating that exposure to infective environments is similar across these groups under the prevailing husbandry systems. Therefore, parasite control programs should emphasize environmental management, rotational grazing, strategic anthelmintic treatment of young stock, and minimizing access to marshy grazing areas harboring infected intermediate host snails.

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