The PHILIPPINE JOURNAL OF
Veterinary Medicine

*(Original Research)*

# Gastrointestinal Parasites in Dairy Cattle in Batu City, Indonesia: Prevalence, Management-Related Risk Factors, and Farmer Practices

*Shelly Kusumarini[1, a,*], Anastasia[2,b], Galang Ardi Darmawan[2,c], Rasendriya N. Ramadhan[2,d], and Nanis Nurhidayah[3,e]*

[1]Department of Parasitology, Faculty of Veterinary Medicine, Universitas Brawijaya, Malang, Indonesia
[2]Bachelor Student, Faculty of Veterinary Medicine, Universitas Brawijaya, Malang, Indonesia
[3]Research Center for Veterinary Science, National Research and Innovation Agency, Bogor, Indonesia

*Corresponding Author: shellykusuma224@ub.ac.id (Shelly Kusumarini)

ORCID Numbers: [a] 0000-0002-7737-6044 [b] 0009-0002-0970-4875 [c] 0009-0004-4126-4499 [d] 0009-0009-7114-0063 [e] 0000-0001-7416-281X

Submitted: 12 Dec. 2025 Revised: 10 Mar. 2026 Accepted: 19 May 2026 Published: 11 Jun. 2026

## Abstract

**Background:** Gastrointestinal (GI) parasitism remains an important endemic problem in tropical dairy systems, yet epidemiological evidence integrating infection patterns with management-related risk factors is limited in Indonesia. Identifying determinants of infection at the population level is essential for targeted parasite control strategies. **Methods:** A cross-sectional epidemiological study was conducted on 400 dairy cattle in Batu City, East Java. Gastrointestinal parasites were identified through microscopic fecal examination using flotation, sedimentation, and the McMaster technique to determine their prevalence in dairy cattle. Data on animal and farm-level variables were collected, and a structured questionnaire was administered to 50 farmers. Associations between risk factors and infection status were analysed using Chi-square tests, odds ratios (OR), and relative risks (RR). **Results:** The overall prevalence of GI parasites was 11.75%. Infections were dominated by *Eimeria* spp. (5.50%), followed by strongyle-type nematodes (2.75%), *Moniezia* spp. (2.50%), *Fasciola* spp. (1.25%), and Amphistome eggs (0.25%). Calves had a significantly higher infection risk than adults (OR = 6.04; RR = 4.12). Closed housing (OR = 2.13; RR = 1.95) and small pen size (<10 cattle; OR = 5.47; RR = 4.77) were identified as key epidemiological risk factors. **Conclusions:** GI parasitism in Batu City is primarily driven by *Eimeria* spp. infections in calves and the use of closed housing systems. These findings indicate that control programs must shift from broad-spectrum deworming to targeted coccidiosis management for young stock and environmental modifications to reduce humidity and fecal accumulation in closed stalls.

### Keywords

Cattle; Epidemiology; Gastrointestinal Parasites; Helminth; Prevalence

## 1. Introduction

Gastrointestinal (GI) helminth infections remain a major constraint on cattle health, welfare, and productivity in tropical livestock systems. These infections arise from interactions among environmental conditions, husbandry practices, and host factors, leading to impaired nutrient absorption, mucosal damage, and metabolic disturbances [1]. Cattle are frequently infected by strongyle-type nematodes (e.g., *Ostertagia*, Haemonchus, Trichostrongylus, and *Cooperia*) and other GI parasites like *Trichuris*, *Capillaria*, *Ascaris*, and *Strongyloides* spp.; trematodes including *Fasciola hepatica* and *Paramphistomum* spp.; cestodes such as *Moniezia* spp.; and protozoa including *Eimeria* spp. and *Cryptosporidium* [2,3]. These infections may elevate serum pepsinogen and gastrin levels, indicating gastrointestinal damage that compromises growth and milk production [4].

In Indonesia, GI helminths are endemic in both dairy and beef cattle systems, facilitated by a warm and humid tropical climate that supports continuous parasite transmission. Meta-analyses report an average prevalence of approximately 46%, while regional studies frequently exceed 50%, reflecting considerable ecological and management-related variability [5–8]. Inter-provincial heterogeneity has been associated with grazing exposure, sanitation, and farming systems [3], with local studies reporting prevalence ranging from 16.5% to 66.7% influenced by manure management, farmer education, age, sex, and production system [5,8,9].

Environmental and management-related risk factors strongly influence the distribution and intensity of infection. Extensive grazing systems, poor sanitation, inadequate manure disposal, insufficient drainage, and earthen flooring enhance larval survival and transmission [10]. Climatic factors such as humidity and rainfall further promote parasite development, while younger animals generally exhibit higher infection rates due to immature immunity [5,8]. Control strategies rely primarily on anthelmintic use, with albendazole being the most commonly administered drug among Indonesian smallholders due to its affordability and broad efficacy [11,12]. However, inappropriate dosing, irregular treatment schedules, and limited diagnostic guidance may reduce treatment effectiveness and accelerate the development of anthelmintic resistance [2,13–15].

Batu City in East Java is an important dairy-producing area and provides a relevant setting for examining GI helminth infections in smallholder systems. The dairy cattle population declined markedly from 13,053 animals in 2022 to 8,500 in 2023 following the first major foot-and-mouth disease (FMD) outbreak in Indonesia [16], intensifying pressure on herd health and productivity [17]. Addressing endemic diseases such as GI helminthiasis is therefore critical for supporting herd recovery. This study aims to assess the prevalence and infection intensity of GI parasites in dairy cattle in Batu City and to examine associated environmental risk factors and farmer behavioral practices to inform practical and sustainable parasite control strategies in tropical dairy systems.

## 2. Materials and Methods

### Ethical approval

All procedures were observational and non-invasive, with informed consent from farm owners. Ethical approval was granted by the Universitas Brawijaya IACUC (No. 092-KEP-UB-2023).

### Study period and sites

The study was conducted in three sub-districts of Batu City, East Java, Indonesia: Batu, Bumiaji, and Junrejo, which are located in the upland dairy-farming region of Malang Raya at elevations ranging from 739 to 1,000 m above sea level. The study area is positioned around 7°50′01″S and 112° 32′ 03″ E (Fig. 1), representing a cool highland agro-ecological zone characterized by smallholder dairy farming systems. Sampling was conducted from July to October 2023 to capture dry season conditions. To validate the environmental context, climatological data were sourced from the Indonesian Agency for Meteorology, Climatology, and Geophysics (www.bmkg.go.id). During this period, the region recorded average temperatures of 25°C–29°C and exceptionally low rainfall (0–20 mm/month). Precipitation was categorized as 'below normal' (0–30%), indicating an intensified dry season. Study sites were selected using a purposive sampling method based on the density of smallholder dairy farms and the prevalence of household-level cattle management.

### Study population and sample collection

Sample size estimation was performed using EpiTools (https://epitools.ausvet.com.au/) at 95% confidence and 10% precision, resulting in a target of 400 dairy cattle. Stratified sampling was applied at the farm level, and animals were selected through simple random sampling from official

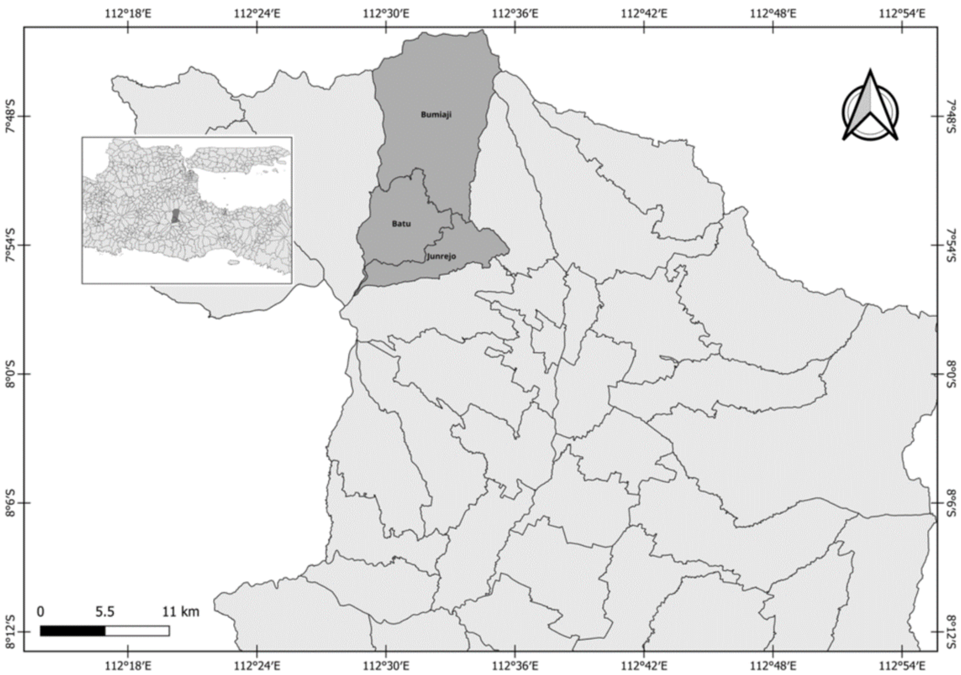


**Figure 1.** Study area encompassing three sub-districts and the dairy cattle population of Batu City, Indonesia. [Source: The base map was obtained from Statistics Indonesia (BPS) East Java, and the figure was generated using QGIS version 3.4.5].

farm rosters. Individual fecal samples were collected per rectum using sterile disposable gloves, placed in labeled containers, and accompanied by basic animal data (sex, age, number ear tags, health status, housing type, and deworming history). Samples were kept in a cool box during transport and processed within 14 hours at the Veterinary Parasitology Laboratory, Faculty of Veterinary Medicine, Universitas Brawijaya.

**Survey instrument**

A structured questionnaire was developed to assess farmers' Knowledge, Attitudes, and Practices (KAP) regarding helminthiasis and anthelmintic use. To ensure clarity and validity, the instrument was pre-tested on a small group of dairy farmers (n = 10) with characteristics similar to those of the target population but who were not included in the final analysis. Based on the pre-test results, minor adjustments were made to the phrasing of questions to ensure they were easily understood by the respondents.

The finalized questionnaire collected demographic variables, including age, educational attainment, years of farming experience, and herd size. The survey consisted of eight items: four attitude-related questions and four practice-related questions. Attitude items were measured using a three-point response scale (agree, disagree, and unknown), while practice items employed a four-point frequency scale (always, sometimes, seldom, and never). Following the scoring framework described by Sazmand *et al.* [13], farmers with an attitude score ≥1 were classified as having a positive attitude toward parasite control, while those with a practice score ≥7 were considered to have appropriate anthelmintic practices.

**Parasitological analysis**

Fecal samples were processed and examined using native smears, sedimentation, and flotation with saturated sodium chloride (NaCl; SG 1.200). Trematode eggs were identified using the Parfitt and Banks sedimentation method [2,18]. The procedure involved homogenizing 1 g of feces in 20 mL of filtered water and allowing it to sediment. The resulting sediment was stained with methylene blue to provide a contrasting background for microscopic examination at 100-400x magnification. *Fasciola* spp. eggs were identified by their golden-yellow coloration and distinct operculum, whereas amphistome eggs appeared transparent to bluish-grey after methylene blue staining. Because amphistome eggs are morphologically similar to those of several taxa within the superfamily Paramphistomoidea, identification in this study was conservatively limited to amphistome eggs based on fecal egg morphology alone [2,26]. Methylene blue facilitated differentiation by darkening the fecal debris while preserving the natural appearance of the eggs.

*Eimeria spp.* were differentiated via sporulation in 2.5% potassium dichromate ($K_2Cr_2O_7$). Infection intensity was quantified using the McMaster chamber technique by homogenizing 4 g feces in flotation solution and converting chamber counts to EPG/OPG [19,20]. To specifically screen for *Cryptosporidium* spp., a subset of fecal samples was further processed using Lugol's iodine and modified acid-fast (Ziehl-Neelsen) staining. Stained slides were examined under oil immersion (1000× magnification) to identify small, spherical oocysts (4–6 µm) [39]. All preparations were examined using an Olympus CX-21 microscope (Olympus Corp., Tokyo, Japan) (100×–400×), with morphometrics captured using an OptiLab Advanced Plus camera (Miconos Corp., Yogyakarta, Indonesia) and ImageJ®. Infection intensity was categorized (low, medium, high) based on species-specific EPG thresholds: strongyle-type eggs <200, 200–1000, >1000 EPG; *Moniezia* spp. <100, 100–800, >800 EPG; *Toxocara vitulorum* <100, 100–800, >800 EPG; and *Trichuris* spp. and *Capillaria* spp. <50, 50–200, >200 EPG [40,41].

### Statistical Analysis

Data were analyzed using the Chi-square test to evaluate differences in proportions. Risk factor analysis was based on overall prevalence because the low prevalence of individual species resulted in expected frequencies below five, which would compromise statistical validity. Associations were reported as Odds Ratios (OR) and Relative Risks (RR) with 95% confidence intervals (CI). Survey validity and internal reliability were assessed using the Pearson Correlation and Cronbach's alpha ($\alpha > 0.6$), respectively. All analyses were performed using SPSS® version 28 (IBM Corp., Armonk, NY, USA).

## 3. Results

### Prevalence of Gastrointestinal Parasites in Dairy Cattle in Batu City, East Java, Indonesia

A total of 400 dairy cattle were examined across 50 farms located in Batu, Junrejo, and Bumiaji subdistricts of Batu City, East Java. The cattle population consisted predominantly of Friesian Holstein crossbreeds. Overall, 11.75% (47/400) of the animals were infected with at least one type of gastrointestinal (GI) parasite (Table 1). Junrejo showed the highest prevalence (5.25%), followed by Batu (3.75%) and Bumiaji (3.25%). The environmental conditions were significantly arid, with rainfall remaining below 0 – 20 mm.

Across the sampled population, four major GI parasite groups were identified: protozoa (*Eimeria* spp.), nematodes (strongyle-type eggs), cestodes (*Moniezia* spp.), and trematodes (*Fasciola* spp. and Amphistome eggs) (Fig. 2). *Eimeria* spp. exhibited the highest overall prevalence (5.50%), confirming that coccidiosis was the most frequently detected infection. Strongyle-type nematodes accounted for 2.75%, followed by *Moniezia* spp. (2.50%). Trematode infections were comparatively rare, with *Fasciola* spp. detected in 1.25% and Amphistome eggs in only 0.25% of animals. In addition to single infections, the study identified specific instances of mixed parasitic burdens. A co-infection involving strongyle-type nematodes and *Moniezia* spp. was observed in 0.75% of the examined cattle. Infection intensity also varied among parasite taxa. Strongyle-type nematodes showed EPG values ranging from 250 to 450, while *Eimeria* spp. showed OPG levels between <50 and 200. Trematode consistently exhibited low shedding (<50 OPG). Furthermore, no *Cryptosporidium* spp. oocysts were confirmed via acid-fast staining in the selected subset of samples.

### Risk Factors Analysis

The prevalence of GI parasite infection among Friesian Holstein crossbred cattle varied significantly with age, housing type, and pen density (Table 2). Age was strongly associated with infection status ($\chi^2 = 29.87$, $p < 0.001$). Calves (<1 year) exhibited a markedly higher prevalence of GI

**Table 1.** Prevalence of gastrointestinal (GI) parasites and egg/oocyst shedding (EPG/OPG) in dairy cattle from Batu District, East Java, Indonesia.

| Location | N examined | N positive (%) | Parasite Class | Species | Predilection Site | % Positive (species level) | EPG/OPG (Mean ± SD, Range) |
|---|---|---|---|---|---|---|---|
| Batu | 238 | 15 (3.75) | Cestode | *Moniezia spp.* | Small intestine | 0.25 | 400 ± 77.46 (300–500) |
| | | | Nematode | Strongyle-type egg. | Intestine | 1.50 | 318.18 ± 52.53 (250–450) |
| | | | Trematode | *Fasciola* spp. | Liver | 0.25 | <50 ± 0 |
| | | | Coccidia | *Eimeria* spp. | Small and large intestine | 1.75 | 82.50 ± 55.81 (<50–200) |
| Junrejo | 121 | 21 (5.25) | Cestode | *Moniezia* spp. | Small intestine | 1.75 | 400 ± 77.46 (300–500) |
| | | | Nematode | Strongyle-type egg. | Intestine | 1.25 | 318.18 ± 52.53 (250–450) |
| | | | Trematode | *Fasciola* spp. | Liver | 0.25 | <50 ± 0 |
| | | | Coccidia | *Eimeria* spp. | Small and large intestine | 2.00 | 82.50 ± 55.81 (<50–200) |
| Bumiaji | 41 | 11 (3.25) | Cestode | *Moniezia* spp. | Small intestine | 0.50 | 400 ± 77.46 (300–500) |
| | | | Trematode | *Fasciola spp.* | Liver | 0.75 | <50 ± 0 |
| | | | Trematode | Amphistome eggs | Rumen | 0.25 | <50 ± 0 |
| | | | Coccidia | *Eimeria* spp. | Small and large intestine | 1.75 | 82.50 ± 55.81 (<50–200) |
| Overall | 400 | 47 (11.75) | - | - | - | - | - |

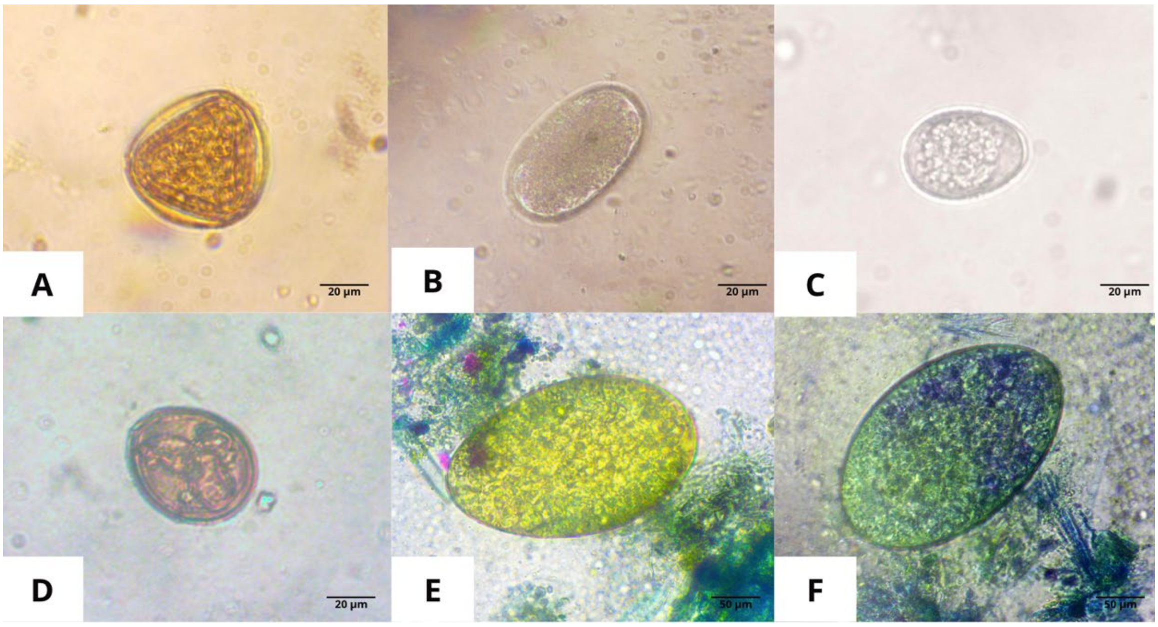


**Figure 2.** Gastrointestinal (GI) parasite eggs and oocysts identified in fecal samples. (A) *Moniezia* spp.; (B) *Strongyle*-type egg.; (C) unsporulated oocyst of *Eimeria* spp.; (D) sporulated oocyst of *Eimeria* spp.; (E) *Fasciola* spp.; and (F) Amphistome eggs. Photos were taken under 400x magnification.

parasite infection than adult cattle (>1 year), with 38.2% (13/34) of calves testing positive compared with 9.3% (34/366) of adults. Calves had 6.04-fold higher odds of infection (OR = 6.04) and a 4.12-fold higher risk of infection (RR = 4.12) than adult cattle.

Housing type was significantly associated with GI parasite infection. Cattle kept in closed housing systems had a higher prevalence of infection than those kept in open housing systems, with 15.8% (30/190) and 8.1% (17/210) testing positive, respectively. Closed housing was

**Table 2.** Prevalence of gastrointestinal (GI) parasites in dairy cattle based on age, housing type, and pen density in Batu City, East Java, Indonesia.

| Variable | No. Examined n (%) | Positive n (%) | Negative n (%) | $X^2$ | p-value |
|---|---|---|---|---|---|
| Age | | | | | |
| Calf (<1 year) | 34 (8.5%) | 13 (38.2%) | 21 (61.8%) | | |
| Adult (>1 year) | 366 (91.5%) | 34 (9.3%) | 332 (90.7%) | 29.87 | <0.001 |
| Housing Type | | | | | |
| Open | 210 (52.5%) | 17 (8.1%) | 193 (91.9%) | | |
| Closed | 190 (47.5%) | 30 (15.8%) | 160 (84.2%) | 5.71 | 0.017 |
| Number of Cattle per Pen | | | | | |
| <10 | 277 (69.3%) | 43 (15.5%) | 234 (84.5%) | | |
| >10 | 123 (30.7%) | 4 (3.3%) | 119 (96.7%) | 15.46 | <0.001 |
| Total | 400 (100%) | 47 (11.8%) | 353 (88.2%) | - | - |

associated with 2.13-fold higher odds of infection (OR = 2.13) and a 1.95-fold higher risk of infection (RR = 1.95) compared with open housing. Figure 3 illustrates the observed housing types, consisting of closed barns located inside or adjacent to households with limited light and ventilation (A–B), and open barns built separately with adequate ventilation (C–D).


**Figure 3.** Housing types observed in dairy cattle farms in Batu City, East Java, Indonesia. (A-B) Closed housing, located inside the farmer's house, with limited light and restricted ventilation, and (C-D) open housing, constructed as a separate building near the house, providing good light and open ventilation.

Pen size was significantly associated with GI parasite infection. Cattle housed in pens containing fewer than 10 animals had a higher prevalence of infection than those housed in pens containing more than 10 animals, with 15.5% (43/277) and 3.3% (4/123) testing positive, respectively. Smaller pens were associated with 5.47-fold higher odds of infection (OR = 5.47) and a 4.77-fold higher risk of infection (RR = 4.77) compared with larger pens.

### Socio-demographic Characteristics and Attitudes / Practices of Dairy Farmers in Batu City, East Java, Indonesia

A total of 50 dairy farmers participated in the study (Table 3). Most were over 50 years old (40%, n = 20), followed by those aged 41–50 years (32%, n = 16) and under 40 years (28%, n = 14). Nearly all farmers had more than 10 years of farming

**Table 3.** Socio-demographic characteristics of dairy farmers participating in the study (n = 50).

| Characteristic | Category | n (%) |
|---|---|---|
| Age (years) | < 40 | 14 (28) |
| | 41–50 | 16 (32) |
| | > 50 | 20 (40) |
| Experience in Dairy Farming | 0–10 years | 1 (2) |
| | > 10 years | 49 (98) |
| Number of Cattle Owned | 1–10 | 39 (78) |
| | 11–20 | 9 (18) |
| | > 20 | 2 (4) |
| Sex | Male | 37 (74) |
| | Female | 13 (26) |
| Breeding activity status | As the main job | 38 (76) |
| | As a side job | 12 (24) |

experience (98%, n = 49). Most owned 1–10 cattle (78%, n = 39), while 18% (n = 9) owned 11–20 animals and 4% (n = 2) owned more than 20. Male farmers predominated (74%, n = 37), and dairy farming served as the primary occupation for most participants (76%, n = 38).

Farmer attitudes and practices regarding helminthiasis management are summarized in Table 4. Overall, respondents demonstrated high awareness of anthelmintic guidelines, with 88% (n = 44) agreeing that treatments should strictly follow label recommendations and 92% (n = 46) recognizing that forage should be harvested at least 10 cm above the ground to minimize parasite risk. Regarding veterinary intervention, 68% (n = 34) acknowledged the importance of professional consultation, while only 10% (n = 5) believed that drug price correlated with efficacy.

In practice, this proactive approach was reflected by 80% (n = 40) of farmers consulting veterinarians and 88% (n = 44) reading drug instructions before administration. Despite these positive attitudes toward forage height, the study

**Table 4.** Attitudes and practices of dairy farmers toward helminthiasis and anthelmintic administration.

| Question | Agree/Often n (%) | Disagree/Sometimes n (%) | Not Sure/Never n (%) |
|---|---|---|---|
| **Attitudes*** | | | |
| - More expensive anthelmintics work better. | 5 (10) | 18 (36) | 27 (54) |
| - Consultation with a veterinarian is necessary before administering anthelmintics. | 34 (68) | 7 (14) | 9 (18) |
| - Anthelmintic administration should follow the dosage indicated on the label. | 44 (88) | 3 (6) | 3 (6) |
| - Forage should be cut 10 cm above the ground. | 46 (92) | 0 (0) | 4 (8) |
| **Practices**** | | | |
| - I consult a veterinarian regarding anthelmintic treatment. | 40 (80) | 4 (8) | 6 (12) |
| - I read the instructions before administering the drug. | 44 (88) | 2 (4) | 3 (8) |
| - I use more than one type of anthelmintic (bolus, injection, pour-on). | 3 (6) | 2 (4) | 45 (90) |
| - I administer deworming drugs by placing them directly into the animal's mouth. | 28 (56) | 3 (6) | 19 (38) |

area relies entirely on a cut-and-carry system from communal areas, which may act as a persistent transmission route. The most common administration route was oral drenching (56%, n = 28), with very few farmers (6%, n = 3) utilizing multiple types of anthelmintics.

## Discussion

The prevalence of GI helminths in Batu City is notably lower than in other regions of Indonesia. For comparison, beef cattle in Sumedang, West Java, exhibit a 47.6% overall prevalence, with 38.1% attributed to strongyle types, while Bangkalan, East Java, recorded a 20% helminthiasis rate during the dry season. Similarly, Malang District and Boyolali have reported fasciolosis rates of 30% and 16.50%, respectively [33–36,42]. This comparatively low prevalence in the study area is likely influenced by a combination of environmental constraints and proactive management.

The low prevalence of *Moniezia* spp. in this study may be attributed to specific forage management practices. Moniezia infections are transmitted through the ingestion of oribatid mites containing infective cysticercoids. Because these mites primarily reside in the lower layers of the pasture, farmers' adherence to appropriate forage cutting heights likely limited the ingestion of these intermediate hosts [23,24]. This suggests that current feeding management serves as a mechanical barrier against tapeworm transmission.

In contrast, infections with Fasciola spp. and amphistomes occur through the ingestion of metacercariae encysted on vegetation near water sources. The arid conditions and below-normal rainfall documented during the study period likely restricted the development of the snail intermediate hosts (*Lymnaea* and *Indoplanorbis*) and the subsequent encystment of metacercariae. Consequently, the combination of environmental stressors and controlled forage harvesting appears to significantly reduce the infection pressure for both cestodes and trematodes in this highland dairy system [37,38].

*Eimeria spp.* infections were detected in dairy cattle but remained subclinical, with no cases of clinical coccidiosis observed. This study identified Eimeria only at the genus level; therefore, species-level attribution was not possible. Pathogenic bovine Eimeria species, such as *E. bovis* and *E. zuernii*, are known to be associated with clinical coccidiosis in cattle, but the absence of clinical signs in this study may reflect low infection levels and management conditions that limited disease expression. Although this study was conducted during the dry season, previous studies have shown that Eimeria transmission may increase under humid conditions. The detection of *Eimeria* spp. during the dry season suggests that environmental contamination may persist even under less favorable conditions. Transmission risk is enhanced by inadequate hygiene, high pen density, shared feeding and watering facilities, poor ventilation, and infrequent cleaning, particularly in intensive and semi-intensive housing systems [30,31].

Age and housing type emerged as important epidemiological determinants in this study. Calves showed a higher prevalence of GI parasite infection than adults (38.2% vs. 9.3%), with 6.04-fold higher odds and 4.12-fold higher risk of infection. This finding likely reflects immature immune responses and limited prior exposure to parasitic antigens in young animals. Cattle kept in closed housing systems also showed a higher prevalence than those in open housing systems (15.8% vs. 8.1%), with 2.13-fold higher odds and 1.95-fold higher risk of infection, probably due to reduced sunlight exposure, limited ventilation, and increased moisture retention that may favor the survival of oocysts and infective stages. In contrast, open housing allows for greater sunlight exposure and ventilation, which suppresses larval development [29].

Notably, while the third-stage larvae (L3) of strongyles possess a double cuticle that enhances environmental resilience, the hot and dry conditions documented during the study period likely accelerated metabolic depletion, thereby reducing larval longevity on the pasture and within open-stall environments. The strategic timing of this study indicates that detectable parasite infections persisted during unfavorable dry-season conditions, suggesting a baseline level of infection pressure that may increase during the rainy season [25,26]. The dominance of strongyle-type nematodes in terms of infection intensity aligns with reports from smallholder dairy systems in Ethiopia and India [21–23].

Farmer behavioral practices significantly influence the therapeutic landscape of the region. While the frequent consultation with veterinarians is a positive indicator for reducing anthelmintic resistance risk, the observed price-quality bias—where farmers equate higher cost with higher efficacy—suggests a need for better evidence-based education [2,13]. Furthermore, the occasional practice of mixing anthelmintics with feed or water risks underdosing, which can accelerate the development of resistant parasite strains [14,27,32]. The increased veterinary supervision following the FMD outbreak likely contributed to the current low infection intensity, as farm-level biosecurity and health awareness were heightened during this period [17].

Despite providing a critical baseline, this study has limitations regarding diagnostic depth. The reliance on morphological identification by microscopy precluded species-level differentiation for several parasite taxa, particularly strongyle-type nematodes, *Moniezia spp.*, and amphistome eggs. In addition, dry-season sampling does not capture the full scale of seasonal fluctuations. Future research should incorporate longitudinal sampling and molecular diagnostics, alongside Fecal Egg Count Reduction Tests (FECRT), to monitor for anthelmintic resistance and provide a comprehensive year-round epidemiological profile.

## 5. Conclusions

This study demonstrates that gastrointestinal parasitism in Batu City's dairy sector is a multifactorial challenge primarily driven by host age and intensive management, with *Eimeria* spp. emerging as the dominant pathogen (5.50%). The significant association between closed housing systems (OR = 2.13; RR = 1.95) and infection status—likely due to increased humidity and fecal accumulation—highlights a critical environmental risk factor that sustains parasite transmission cycles. Furthermore, the high vulnerability of calves (OR = 6.04; RR = 4.12) suggests that current control measures are insufficient for young stock. Therefore, effective parasite management in East Java must transition from generic deworming to an integrated paradigm that prioritizes coccidiosis control in calves, improves hygiene within closed stall designs to disrupt oocyst maturation, and supports veterinarian-guided anthelmintic use with periodic efficacy monitoring to mitigate the future risk of anthelmintic resistance.

## Abbreviations

EPG, Egg Per Gram; FECRT, Fecal Egg Count Reduction Test; FMD, Foot-and-Mouth Disease; GI, Gastrointestinal; L3, Third-stage larvae; OPG, Oocyst Per Gram; OR, Odds Ratio; RR. Relative Risk (or Risk Ratio).

## Availability of Data and Materials

All data related to this study is available in the manuscript.

## Author Contributions

Conceptualization: S.K., and N.N.; Methodology: S.K., R.N.R., and N.N.; Investigation: A.S., G.A.D., and R.N.R.; Writing - original draft: S.K., A.S., and R.N.R., G.A.D.; Writing - review & editing: S.K., and N.N.; Finding Acquisition: S.K.; Resources, S.K.; Supervision, S.K., and N.N.

## Ethics Approval and Consent to Participate

This study was approved by the University Brawijaya Ethics Committee (approval no. 092-KEP-UB-2023).


## Acknowledgments

The authors express their sincere gratitude to the local government units, veterinary offices, and agricultural offices in Batu City for their assistance and cooperation during data collection. The authors also thank all dairy farmers who participated in this study for their time, collaboration, and willingness to share information essential to this research.

## Funding

This study was financially supported by the Faculty of Veterinary Medicine, Universitas Brawijaya, through the DPP SPP scheme awarded to Shelly Kusumarini, DVM, M.Sc (Grant number: 1450/UN10.F13/TU/2023).


## Conflict of Interest

The authors declare no conflict of interest.

## References


[1] Su, L., Kamboh, A., Matar, A., Leghari, R., & Kumar, C. (2024). Assessment of gastrointestinal nematode infections in dairy cattle and the associated risk factors in Northern China. *Journal of Veterinary Science, 25*, e173. https://doi.org/10.4142/jvs.24173.

[2] Taylor, M.A., Coop, R.L., & Wall, R.L. (2016). *Veterinary Parasitology* (4th ed.). Wiley-Blackwell.

[3] Ninditya, V., Ekawasti, F., Prastowo, J., Widiyono, I., & Nurcahyo, W. (2024). Prevalence of gastrointestinal parasites in cattle in Indonesia: A meta-analysis and systematic review. *Veterinary World, 17*, 2675–2687. https://doi.org/10.14202/vetworld.2024.2675-2687.

[4] Springer, A., Jordan, D., Kirse, A., Schneider, B., Campe, A., Knubben-Schweizer, G., Müller, K., Hoedemaker, M., & Strube, C. (2021). Seroprevalence of major pasture-borne parasitoses in German dairy cattle herds and association with management factors and production parameters. *Animals, 11*(7), 2078. https://doi.org/10.3390/ani11072078.

[5] Nurcahyo, R., Ekawasti, F., Haryuningtyas, D., Wardhana, A., Firdausy, L., Priyowidodo, D., & Prastowo, J. (2021). Occurrence of gastrointestinal parasites in cattle in Indonesia. *IOP Conference Series: Earth and Environmental Science, 686*, 012063. https://doi.org/10.1088/1755-1315/686/1/012063.

[6] Martindah, E., Sawitri, D., Sani, Y., Yulistiani, D., Kusumaningrum, D., Widiawati, Y., & McCoascker, K. (2022). Investigation of helminth infections on smallholder beef cattle at palm–cow integration systems in Indonesia. *Advances in Biological Sciences Research, 13*, 170–175. https://doi.org/10.2991/absr.k.220207.027.

[7] Zalizar, L., Winaya, A., Ridwan, Y., Hardiansyah, E., & Jaganathan, R. (2023). Prevalence of gastrointestinal helminthiasis in beef cattle during the dry season in Madura, Indonesia. E3S Web of Conferences, 374, 00021. 1–7. https://doi.org/10.1051/e3sconf/202337400021.

[8] Strydom, T., Lavan, R., Torres, S., & Heaney, K. (2023). The economic impact of parasitism from nematodes, trematodes and ticks on beef cattle production. *Animals, 13*(10), 1599. https://doi.org/10.3390/ani13101599.

[9] Kurnianto, H., Ramanoon, S.Z., Aziz, N.A.A., & Indarjulianto, S. (2022). Prevalence, risk factors, and infection intensity of fasciolosis in dairy cattle in Boyolali, Indonesia. *Veterinary World, 15*(6), 1438–1448. https://doi.org/10.14202/vetworld.2022.1438-1448.

[10] Tiele, D., Sebro, E., H/Meskel, D., & Mathewos, M. (2023). Epidemiology of gastrointestinal parasites of cattle in and around Hosanna Town, Southern Ethiopia. *Veterinary Medicine: Research and Reports, 14*, 1–9. https://doi.org/10.2147/vmrr.S389787.

[11] Plumb, D. C. (2008). *Plumb's Veterinary Drug Handbook*. PharmaVet Inc.

[12] Ginting, R.B., Ritonga, M.Z., Putra, A., & Pradana, T.G. (2019). Program manajemen pengobatan cacing pada ternak di kelompok tani ternak Kesuma Maju desa Jatikesuma Kecamatan Namorambe. *Journal of Animal Science and Agronomy Panca Budi, 4*(1), 43–50.

[13] Sazmand, A., Alipour, G., Zafari, S., Zolhavarieh, S. M., Alanazi, A. D., & Sargison, N. D. (2020). Assessment of knowledge, attitudes and practices relating to parasitic diseases and anthelmintic resistance among livestock farmers in Iran. *Frontiers in Veterinary Science, 7*, 584323. https://doi.org/10.3389/fvets.2020.584323.

[14] Velde, F., Charlier, J., Hudders, L., Cauberghe, V., & Claerebout, E. (2018). Beliefs, intentions and beyond: Adoption of sustainable gastrointestinal nematode control practices. *Preventive Veterinary Medicine, 153*, 15–23. https://doi.org/10.1016/j.prevetmed.2018.02.020.

[15] Keyyu, J.D., Kassuku, A.A., Kyvsgaard, N.C., & Willingham, A.L. (2003). Gastrointestinal nematodes in indigenous zebu cattle under pastoral systems in Tanzania. *Veterinary Research Communications, 27*, 371–380. https://doi.org/10.1023/A:1024706120270.

[16] Badan Pusat Statistik. (2023). *Statistik peternakan Kota Batu*. https://www.bps.go.id.

[17] Prama Rangga, I., MacPhillamy, I., Handaru, S., Matsumoto, N., Zalcman, E., & Madin, B. (2026). A case report of the 2022 foot-and-mouth disease outbreaks in Indonesian feedlots. *Preventive Veterinary Medicine, 246*, 106739. https://doi.org/10.1016/j.prevetmed.2025.106739.

[18] Nugraheni, Y.R., Priyowidodo, D., Prastowo, J., Rohayati, E.S., Sahara, A., & Awaludin, A. (2018). Parasit gastrointestinal pada sapi di DAS Progo, Yogyakarta. *Jurnal Ilmu Peternakan Terapan, 1*(2), 46–50. https://doi.org/10.25047/jipt.v1i2.889.

[19] Sasmita, R., Mussa, O.H.P.A., Benu, H.A., & Widhowati, D. (2019). Infeksi endoparasit pada kucing domestik (*Felis domesticus*) di pasar tradisional Kecamatan Sawahan, Kota Surabaya. *Jurnal Vitek Bidang Kedokteran Hewan, 9*, 38–43. https://doi.org/10.30742/jv.v9i0.67.

[20] Kusumarini, S., Danuarta, M.F., Karami, F., Yesica, R., Wisesa, I.B.G.R., Yudhana, A., & Nurhidayah, N. (2022). Screening *Strongyloides* spp. infection from wild rodents: Implications for public awareness and attitudes on zoonotic diseases in Malang City, Indonesia. *Jurnal Medik Veteriner, 5*(2), 196–206. https://doi.org/10.20473/jmv.vol5.iss2.2022.196-206.

[21] Siyoum, T., & Kitaw, G. (2014). Comparative milk production and prevalence of parasites in indigenous cows. *Ethiopian Veterinary Journal, 18*, 43–56.

[22] Haymanot, F., & Kaba, T. (2022). Prevalence and associated factors of gastrointestinal helminthiasis in lactating cows. *BMC Veterinary Research, 18*, 96. https://doi.org/10.1186/s12917-022-03251-2.

[23] Renwal, K.K., Gupta, A., Kumar, N., Pilania, P.K., & Manohar, G.S. (2017). Prevalence and risk assessment of gastrointestinal helminthoses in dairy animals. *Journal of Parasitic Diseases, 41*(2), 557–561. https://doi.org/10.1007/s12639-016-0850-x.

[24] Habib, A., Arif, R., & Ridwan, Y. (2022). Prevalensi dan faktor risiko helminthiasis pada sapi Limousin. *Jurnal Kajian Veteriner, 10*(1), 29–37. https://doi.org/10.35508/jkv.v10i1.6562.

[25] Das, M., Deka, D.K., Islam, S., Sarmah, P.C., & Bhattacharjee, K. (2016). Gastrointestinal nematode larvae in grazing land of cattle. *Veterinary World, 9*, 1343–1347. https://doi.org/10.14202/vetworld.2016.1343-1347.

[26] Purwaningsih, P., Noviyanti, N., & Putra, R. (2018). Prevalence and risk factors of paramphistomiasis in Bali cattle. *Jurnal Veteriner, 19*(1), 91–99. https://doi.org/10.19087/jveteriner.2018.19.1.91.

[27] Nur-Shabrina, A., Muhamad-Ali, H., Nur-Amalina, N., Hasimah, H., Wan-Ladiana, W., & Hayyan, B. (2024). Relationship between parasitism, milk yield and body weight of Mafriwal cattle. *Veterinary Integrative Sciences*. https://doi.org/10.12982/vis.2024.012.

[28] Nurhidayah, N., Satrija, F., Retnani, E., Astuti, D., & Murtini, S. (2019). Prevalence and risk factors of gastrointestinal parasites in swamp buffalo. *Jurnal Veteriner, 20*(4), 572–582. https://doi.org/10.19087/jveteriner.2019.20.4.572.

[29] Shatyaayyupranathasari, H.P., Sudarnika, E., & Ridwan, Y. (2021). Prevalensi dan faktor risiko infeksi cacing saluran pencernaan pada kuda delman. *Acta Veterinaria Indonesiana, 9*(2), 87–96. https://doi.org/10.29244/avi.9.2.87-96.

[30] Fitriastuti, E.R., Atikah, N., & Isriyanthi, N.M.R. (2012). Studi penyakit koksidiosis

pada sapi betina di Indonesia. *Buletin Pengujian Mutu Obat Hewan, 9*(18), 35–37.

[31] Hastutiek, P., Suwanti, L., Suprihati, E., Lastuti, N., Wardhana, A., Pradana, M., & Kurniawan, M. (2025). Bovine coccidiosis and molecular characterization of pathogenic Eimeria species in dairy cattle on Grati–Pasuruan, East Java, Indonesia. *Open Veterinary Journal*, *15*, 1549–1556. https://doi.org/10.5455/ovj.2025.v15.i4.5.

[32] Suolaniemi, J., Autio, T., Heikkinen, J., & Räsänen, K. (2022). Knowledge, attitudes, and practices of Finnish dairy farmers. *Journal of Agromedicine, 28*, 288–299. https://doi.org/10.1080/1059924X.2022.2112417.

[33] Shephard, R., Hancock, A., Playford, M., & Oswin, S. (2022). A systematic review and meta-analysis of impact of strongyle parasitism on growth rates in young cattle. *Veterinary Parasitology*, *309*, 109760. https://doi.org/10.1016/j.vetpar.2022.109760.

[34] Strydom, T., Lavan, R., Torres, S., & Heaney, K. (2023). The economic impact of parasitism from nematodes, trematodes and ticks on beef cattle production. *Animals: An Open Access Journal from Multidisciplinary Digital Publishing Institute (MDPI)*, *13*. https://doi.org/10.3390/ani13101599.

[35] Ninditya, V., Haryadi, F., Ekawasti, F., Prastowo, J., Widiyono, I., & Nurcahyo, R. (2024). The prevalence of gastrointestinal helminth parasites from beef cattle on Sumedang Regency, Indonesia. *Institute of Physics (IOP) Conference Series: Earth and Environmental Science, 1360*. https://doi.org/10.1088/1755-1315/1360/1/012018.

[36] Aryani, I., Suyadi, S., Hartutik, H., & Kuswati, K. (2022). Prevalence and diversity of gastrointestinal endoparasite in Madura Cattle at Papabaru, East Java, Indonesia. *Advances in Animal and Veterinary Sciences*. https://doi.org/10.17582/journal.aavs/2022/10.10.2171.2177.

[37] Khan, M., Sajid, M., Khan, M., Iqbal, Z., & Hussain, A. (2010). Gastrointestinal helminthiasis: Prevalence and associated determinants in domestic ruminants of district Toba Tek Singh, Punjab, Pakistan. *Parasitology Research*, *107*, 787-794. https://doi.org/10.1007/s00436-010-1931-x.

[38] Bricarello, P., Longo, C., Da Rocha, R., & Hötzel, M. (2023). Understanding animal-plant-parasite interactions to improve the management of gastrointestinal nematodes in grazing ruminants. *Pathogens, 12*. https://doi.org/10.3390/pathogens12040531.

[39] Kadir, M., Othman, N., & Salman, Y. (2004). Comparison between the efficacy of different laboratory methods for diagnosis of Cryptosporidium. *The Iraqi Journal of Veterinary Medicine*. https://doi.org/10.30539/ijvm.v28i1.1084.

[40] Telila, C., Abera, B., Lemma, D., & Eticha, E. (2014). Prevalence of gastrointestinal parasitism of cattle in East Showa Zone, Oromia Regional State, Central Ethiopia. *Journal of Veterinary Medicine and Animal Health, 6*(2), 54–62. https://doi.org/10.5897/JVMAH2013.0260.

[41] Henriques, R., Pereira, F., De Paiva, J., Silva, M., & Melo, R. (2021). Profile of endoparasites in dairy cattle in the microregion of São João del-Rei, state of Minas Gerais, Brazil. *Arquivo Brasileiro de Medicina Veterinária e Zootecnia*. https://doi.org/10.1590/1678-4162-12013.

[42] Kusumarini, S.R., Permata, F.S., Widyaputri, T., & Prasetyo, D. (2020). Prevalence of fasciolosis emphasis on age, origin, body condition and post mortem by geographic information systems on sacrificial examination in Malang District–East Java. *Journal of Physics: Conference Series*, *1430*(1), Article 012025. https://doi.org/10.1088/1742-6596/1430/1/012025.